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IS HYPERTEXT A MORE FLEXIBLE TEACHING TOOL FOR EDUCATION?

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Hypertext (HT) is nonlinear and nonsequential text. The paper gives a brief over view of HT, its definition and salient features. It also describes why HT is required for teaching and what are its strengths and weeknesses for using it as a teaching tool in education. It also points out the important reasons for using HT as teaching tool and its impact on education.

INTRODUCTION

Human thinking is not sequential, though it becomes sequential when it is written for a speech. Since the birth of paper and book, the literature has been recorded in sequential and linear fashion and this practice is still continuing today. In reality, there are many cognitive lines between topics and subjects, because the entire Universe of knowledge is inter-linked and inter-related. Hypertext (HT) is nonsequential text, which offers the possibility of representing and exploring knowledge more originally and naturally.

There are about 100 different types of HT/ Hypermedia (HM) systems developed by different people for various purposes. At present about a dozen of organisations/ institutions/universities are working full time in developing such systems. HT is one of those softwares, through which one can develop courseware from kinder garden to advanced research. It has got a lot of potentialities which any good teaching technique must have. Therefore, a number of schools, colleges and universities have already started using it for designing their courseware, presentation of information and developing both interactive video and computer based instructions.

HYPERTEXT AND HYPERMEDIA

The concept of Hypertext was originated by Dr. Vannevar Bush, when he was working as Science Adviser to Roosevelt, President of the USA, in 1945. During those days he foresaw the problem of future information explosion and developed a mechanical recording device, which he called 'Memax' to cope with his own information needs.

Afterwords, in 1950s, Douglas C. Engelbart, a pioneer in computer science picked up the same idea and developed a system called 'Online System (NLS)' with all those features. He also invented the mouse and five key chord input devices and many more things related to HT.

The third pillar of HT is Theodor H. Nelson, a computer guru who first coined the word 'Hypertext' in 1965 [2] and also many other words and new concepts related to this field. It may be that Bush is the originator, Engalbart is the developer, and Nelson the disseminator of the idea to the world. Nelson defined HT as follows:

"HT is the combination of natural-language text with the computer's capacities for interactive, branching or dynamic display...... of a nonlinear text......... which cannot be printed conveniently on a conventional page......" [3].

This lead to the modern definition of HT as follows:

"A large number of information fragments/ chunks (such as text, graphics and images) linked together electronically forming a multifaceted indefinite shaped database in which one can write and read the information nonsequentialy and nonlinearly".

Hypermedia (HM) is simply an extension of HT with which authors can create a linked corpus of materials that includes text, static graphics, animated graphics, video, sound, music, etc. [4]. The difference between HT and HM is that an HT system allows authors to link together only textual information blocks, whereas an HM system provides linking capabilities between heterogeneous blocks of information created with different applications. So HM is a frame work for nonlinear representation of text, graphics, images, sound and animation in the computer.

PRINT MEDIA vs HYPERTEXT

In spite of many disadvantages of paper media for structuring text, its use has continued for the past seven centuries. It is, of course, very convenient and one can place all the books, periodicals, reports, notes, and other forms of information sources on the same table and read, compare and work with them. Whereas with other media like audio, video, magnetic and optical media, it is yet not possible to store heterogeneous formats of information on one platform/base, and even if it is possible, comparing would not be so convenient as in the case of print media. Perhaps easy to use, store, read etc. are very strong advantages of the paper media because of which it was not replaced by any other media for a long time.

Many HT systems differ from their print versions on paper in many ways including its structure, organization and functionality. Reading full text in HT is much slower than printed version but other advantages like interactiveness, browsing, navigation through a great volume of text must be set against its disadvantages. In print version also, one can create HT features in a document by creating nodes in the linear text, but this is not as effective as in the electronic form. Ben Shneiderman's 'Hypertext hands-on! an introduction to a new way of organising and accessing information' is an example for both the print and the computer version of the book in HT format. There are two and a quarter inches disks coming with it which contain Hyper TIES (a n HT system) version of that book. Print version of the book is not found as affective as the computer version.

Browsing is an important aspect of information search even in electronic environment. There are a number of effective browsing techniques in HT, but the prominent ones range from random and informal to systematic and formal. Since HT is always dynamic, the organization of a document is such that the reader is not at all limited by only nodes but there are also so many other advantages. HM/HT system allows users to browse and navigate quickly through any complex networks of information, and find explanations, references, comparisons, definitions etc. from the nodal points created in the system which gives a HT a considerable potential in developing and using the courseware for the students.

SALIENT FEATURES OF HYPERTEXT

In HT, knowledge (information) is represented in frames (Knowledge Management Systems or KMS), cards (Hypercards, Notecards), nodes, i.e. Geographical Issue Based Information Systems (GIBIS), etc. The information may be a paragraph, a diagram, a graphic or a combination of any of these items. By inter-linking all the small chunks/ fragments of information, a HT database is formed.

Following are the salient features of a HT database.

- Users can rapidly navigate within a HT database, moving from one chunk to another by selecting/clicking on them is easy.
- A user can create, edit and rearrange the chunks according to his interest and needs.
- The user is able to see even a small fragment of information at any time even in a large HT database.
- In HT, there are no hierarchical page boundaries like a conventional book.
- In a HT systems, the user can navigate by moving rapidly in either direction between the nodes of the HT database.
- In a HT environment, the computer brings the user close to natural human knowledge processing. Even though HT does not incorporate an artificial intelligence (AI) concept like an Expert System (ES), it is

more useful than the ES in enhancing human skills and knowledge effectively.

- A n HT system allows the user to access information by both associative and intuitive routes, irrespective of knowledge of the actual location of information or any visible database structure.

- To a large extent, HT leaves control of information in the hands of users.

- The HT database can have a changeable structure (like an amoeba) It keeps on changing according to the author(s) or designer(s) addition, deletion or editing of the text, graphics, images, etc. It does not have a clear structure like a conventional book in which the length and breadth can be defined. Moreover the arrangement of information in the HT database changes every time according to the user's interaction.

- In HT environment, there is no difference between author and reader or teacher and student. All are equal.

- Unlike a printed book, HT is multifaced with many entry points to add or retrieve information according to the need/requirement, level of interest and learning style of the user population.

HYPERTEXT AS A TEACHING TOOL

Use of movies, audio-visual (A-V) materials like transparencies, slides, audio tapes, etc., and Computer-Aided Instructional (CAI) materials was initialy introduced in the educational technology to supplement the traditional teaching methods. But none of them replaced the conventional teaching methods. The teaching aids changed the position of the instructor from teacher to helper. Almost a revolution took place in the field of educational technology when videos and computers were introduced as teaching aids/tools for teaching in the schools, colleges and universities. The educationists started developing their lessons in the form of video tapes and CAI programs in which students could listen, watch and interact with the course material. When using it, if a student could not understand a particular concept, he/she could replay that part as many times as required and clear the doubts.

In the 1970s and 1980s, a number of new teaching tools/methods were introduced such as Expert systems Interactive Video Disc (IVD), Computer Aided Learning (CAL), Computer Based Training (CBT), Multimedia and the recent HT. HT has got powerful interactive methods. It is very simple and fast in retrieving associated information from the database. HM has gone a step further by incorporating other media elements to text. It is one of the most important recent innovations in the field of educational technology and has made a lot of impact on students in their learning processes. Because of its non-linear writing and inter-linking of information fragments, called 'seamless information',it provides random access to a piece of information in a database. A major problem is that both HT and HM require good data modelling to interlink the data files, The beauty of HT for teaching is customizing and developing personal links inbetween the information fragments in a hypertext database.

REVIEW OF LITERATURE ON USE OF HT

HT has got lot of potential and flexibility in the ways of presenting the teaching materials. The students may change it as they want and understand fully. Moreover, as compared to other teaching tools, it is easier to experiment and reorganize the information in the reading materials. HT offers innumerable possibilities for teaching and learning to both the students and the teachers of any subject. Research on this topic suggests that HT cultivated among the students, the habit of critical thinking, skilled reading and logical linking of related fragments of information [5]. It is a good tool for the students because they can assimilate a large portion of information while reading and developing links. Thus it is not only possible to use HT to present the basic informtion on a subject, but also to encourage analytical thinking about the presentation and linking of that information. The capacity to allow multiple links to an individual chunk of information may encourage the students to cultivate the habit of approaching any information fragment from multiple directions and thinking critically to add their comments. Moreover it makes the students participate in the teaching and learning program rather than the passive type of learning in traditional teaching.

In an HT environment, when a student is given a selected list of readings (hypertext courseware materials) for doing an assignment, normally without going through all those materials, the student cannot complete the assignment satisfactorily. Whereas in traditional teaching, the students may do selective readings for completing their assignments or coursework, with the result that the students are not reading even the prescribed syllabus. As a result they do not understand the subject fully, which ultimately effects the basic purpose of education. This is one of the strongest factors of HT which achieves one of the main objectives of education, which other CBT systems or A-V tools could not achieve from ages together.

Another advantage of HT is that during learning process the student develops authoring skills and also start contributing his views as notes, new thoughts, arguments, comments, etc. which ultimately affects the growth of HT system. The student may feel more responsible because his contributions will be referred to by other students and teachers. This does not only help the students in establishing a communication link between the learning community of the system but also provides them chance to present their ideas. HT has got multifaced instructional applications in all areas of curriculum. The teachers would have an infinitely greater range of choice over what to teach. Many instructors in different schools, colleges and universities have started developing HT systems for teaching.

Brown University's English and Biology departments were the first to use the hypertext for teaching at the University level and found that the students who used these materials were not only quick to grasp the subject, but also developed analytical thinking and designing skills [6]. So during the teaching process, HT as a teaching tool reflects on students' thinking and improves their metacognitive skills.

In the University of Southern California it was observed that the students of Freshman Writing Program "Project Jefferson" felt difficulty in accessing information in the library for their composition class which resulted in poor quality of their research papers. To overcome this problem, Clark started the 'Project Jefferson' using Hypercard for teaching the fundamental research skills like how to get information and utilize it for their academic writing. Eventually, she found that HT made profound impact on the students in improving their academic writing [7]. Kay E. Vandergriff of the State University of New Jersey has selected Edna St. Vincent Millay's poem "Justice Denied in Masschussets" and designed a Hypercard stack for teaching. Since Poetry is the neglected area in the literature, he took a poem as an example and experimented in developing a Hypercard courseware for teaching his students. He also suggested the librarians to build the stackware collection in the libraries and the ways to overcome the copyright problems but has not reported the impact of that courseware on the students [8].

A number of departments at the University of Toledo, such as Department of Educational Technology, Biology, Foreign Languages and some others are developing their courseware in the form of Computer-Based Instructional materials and Interactive video programmes using Hypercard software. The response of the students seems to be noticeable [9].

In a class, after some exposure to the system, the students were observed to develop the stories on art education and needed a little intervention by the tutor to guide them in extending their abilities [10]. They liked to submit their assignments in hypertext form rather than traditional form.

At Wayne State University, John Camp and Mare Cogan have developed "The School of Athens", a stackware for the art students with the help of Hypercard. The art lessons in the form of stackware influenced the students' participation and created interest in teaching to a great extent [11].

At Coventry Polytechnic, Alan Dyer has investigated a number of problems related to HT and art & design teaching. They found that the students' creative capabilities were expanding after using the HT courseware both in theoretical studies and studio design work [12].

The most interesting observation was that several students were enthusiastic in submitting their assignments (i.e. essays, thesis, etc.) in the form of HT documents. The department is now investigating the impact i.e. special cognitive skills and educational benefits of HT on the students while authoring their course work.

"The Living Textbook of Pathology" is an interactive HT system developed to provide a framework for interactive growth and updating of an under graduate pathology curriculum. The living text system utilizes a matabase which is a database about the databases. This system consists of various types information like what type of users, how and where, can get and save the information, and who is (are) the author (s) of those information fragments, etc. A number of important lessons were developed on this system and the use of the system by the students was also recorded, which was very significant i.e. 3600 hours for all lessons. At that time they could not measure or find any direct impact on the undergraduate medical students because of its prototypeness, but found its usefulness for the continuing education of practicing physicians, even at the beginning of its development [13].

"Training the Trainers", a n HT based training package was designed by Philip J. Gartshore, school of Architecture, Portsmouth Polytechnic to study various methods of students learning. The package was designed with HyperCard software and implemented on an IVD. It was also found that this training package motivated the students in using it more and more [14].

In 1989, Drexel University has developed HyperCard based HT instructional software tool called 'Drexel Disk' for distributing the day-to-day required basic information about the University, its departments and facilities available to all the newly joined students. They found that the distribution of disks are comparatively cheaper than the printed brochures containing the same information. In a study it was found that the students were satisfied with the disk except its up-to-dateness [15].

In another case at Rentgers University's library of Science and Medicine Department has also designed LSM Infomaster: a HyperCard based CAI program for giving introductory training for all the freshly joined engineering students. It was found to be quite useful but they have not studied the impact of that software on the students [16].

General Electronics Corporation's Unit at East Cleveland (GE-Lighting) has developed a prototype Machine Adjester's Helper (MAH), a PC based HT system for training their mechanics. MAH system was designed with two subsystems, i.e. a n HT subsystem with textual and graphic information intended for training and another diagnose subsystem which has an expert system to diagnose the troubleshooting production problems. During their experimental stage itself, it was found to be very much useful in boosting both the parameters, i.e. the materials efficiency and the machine uptime [17]. It was also found that the system is very much user-friendly and none of their mechanics pointed out any negative criticism about the system.

It is generally regarded as difficult and time-consuming to design a good training programme. The teachers who design courseware should envisage the needs of slow learners as well as the intelligent students. In general, the designer of machine learning system unlike HT, should undertake expensive experimentation and debugging. Linking of fragments in the web must be tested and all those sequences should be easily available to the student to understand the subject/topic effectively. Misunderstanding of the students should also be anticipated and prevented . carefully while sequencing and linking the thought contents.

REASONS FOR USING HYPERTEXT AS A TOOL FOR TEACHING/LEARNING

Following are some of the reasons for using HT as a teaching tool.

1) The main reason of using HT for teaching is that a student will use his/her optimum freedom according to his/her choice because the text in HT is presented more

naturally than sequentially. Moreover the boundaries of the subject fields are arbitrarily unlike the printed book.

2) Normally while browsing a conventional printed book, people do not read the entire book. They generally read the required portion from the book in their own way. HT provides connections and relations between the information fragments scattered at various places.

3) HT makes it possible for the students to make marginal notes or highlight the portions of text.

4) Since the information in HT is arranged in associative linked form, one can retrieve additional depth of knowledge on a specific aspect just by clicking on an active node with the mouse.

5) Publications are conventionally aimed at a particular level of audience, for example, text books are for students, articles are for researchers and so forth. In HT, a single form could serve the purpose of the elementary reader to the adult/advanced researchers; depending upon the level of user's interaction and the approach to the database.

6) In HT, one can present the teaching materials, with a combination of graphics, animation, sound and text in a dynamic form which is better than any other existing teaching aid such as CAL, Computer Based Education (CBE), CBT, A-V materials, etc.

7) One of the aims of HT is to improve the existing learning practices. So in HT, the main strategy of learning is by exploring the information by the learner, which is a powerful capability. Here learner is completely independent to move, learn and to take independent decisions.

8) HT also allows individual instructions to the learner which is normally difficult in traditional teaching.

9) Collaborative writing is one of the features of the HT which is useful for education in which a number of people could share the ideas, works, designs in their development. KMS is the best example for this.

10) Inter-linking of ideas and concepts is one of the useful aspects of HT for teaching. Almost all the HT systems support the easy creation and inter-linking of the information fragments which will be useful for easy navigation and browsing the HT databases by the students.

11) Continuous creation and updation feature of HT is one of the many advantages for teaching which is a bit difficult and also time consuming process incase of books and other teaching materials.

12) In HT, one can write new ideas/concepts and add individual views for the existing ones and also link them with the other ideas/views.

IMPACT OF HYPERTEXT ON EDUCATION

The impact of HT may be mainly envisaged in three areas:

a) The replacement of traditional oral medium by the dynamic visual media with graphics, images etc.
b) Specialized training course for the HT courseware developer by incorporating areas like HCI, graphics, programming, educational psychology, cognitive studies, etc.
c) The development in analytical/thinking and skills of students.

Research results indicate that after using HT, students have developed their critical thinking skills comparatively more in their teaching process [18]. The student who had access to HT course materials was found to grasp and understand better than others.

DISADVANTAGES OF HYPERTEXT

Poor designing is one of the most common problems in many of the HT systems. The text in the HT is in the form of broken fragments. Therefore, if the links are not successful or logical, it will be neither attractive nor effective. So, the HT author or developer should be a good designer with a good bit of knowledge in HCI, cognition studies, computing, education psychology, and subject knowledge.

Another major problem of HT is that the bigger the system, the possibility of getting lost in the system is greater. In general, if the number of nodes/chunks increase from a certain level, the complexity of hyperspace which is proportionate to the user's chances of getting-lost in the system is also increased. Even though different systems are providing different methods to keep track of the users'path, the possibility of getting lost is not ruled out. Unless the user knows the reading skills and knowledge organization of HT system, he cannot make an optimum use of it. following are some of the drawbacks of the HT system.

1) The systems are incompatible due to lack of standardization in HT systems.
2) According to theoretical definitions, so far no full fledged ideal HT system is built, with the result that the idea is not very much popularized.
3) The HT database is generally very large and a new learner finds it difficult to keep control of it and hence loses interest.
4) Lack of good designers of HT databases.
5) In case of bigger HT ststems, they are neither portable nor easily accessible like books by everybody.
6) Designer's or author's copyright for the software is not well protected.
7) Learner has to put some extra efforts in remembering/concentrating on the system to maintain several tasks at a time which causes some strain on him. This is called 'cognitive overhead' problem.
8) Reading of HT courseware materials is more slower than books and also causes lot of strain on reader's eyes and mind.

CONCLUSIONS

Even though the idea of HT was introduced earlier than the development of the computer, it did not popularize just because people did not clearly understand its main theme. It started becoming popular only from the last four years. It was when Apple Computers started supplying its HyperCard system free of cost with the purchase of any of their Macintosh computer that the idea of HT started gaining popularity. Now HyperCard, an HM system has made amazing impact on people's thinking and the concept is spreading day-by-day and is being used for teaching in schools, colleges and universities throughout the world. Inspite of its few drawbacks, HT has got tremendous potential for any application in which information has to be retrieved and presented effectively to the users. Since the main output of this media is in visual form which is very familiar to the general public, it will definitely become more popular in future.

Now the main task is to develop good vocabulary, syntax, structure and behaviour of various forms of text, etc. in order to get maximum benefits out of it. HT has profound influence on education and scholarship, especially during the past six years. It was clearly observed that after using HT, students improved skills such as creativity, flexibility, decision making, evaluation and synthesis of information, confidence building etc. Designers of HT system are trying their best to eliminate its drawbacks and improve their usability. Comparatively, the number of people involved in conducting research in this field has increased in multi-folds during the last four decades. If these systems over come the problem of incompatibility, the mass introduction of hypermedia materials in education through out the world is expected very soon.

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COLLABORATION TRENDS IN SUGARCANE RESEARCH - A CASE STUDY

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In order to findout the collaboration trends in Sugarcane Research, a case study has been undertaken with the help of publications from Sugarcane Breeding Institute, Coimbatore during 1948 to 1987. Disciplinewise Collaboration Coefficient (CC) and Average Authorship per Paper (AAP), were calculated. It was noticed that both CC and AAP increased steadily over a period of time. The relationship between these two factors indicates positive direction but with varied magnitudes among the disciplines.

INTRODUCTION

Measuring Science has become a major aim and concern for a variety of reasons. All those who are studying the evolution of science epistemologically, or interested in the history or sociology of the scientific community, or dealing with decision making for the management of science, need a frame work in which various aspects of science can be assessed in as quantitative manner as possible [1]. The openly published scientific paper or its functional equivalent may be regarded as the end product of scientific research [2]. It is well known that the number of authors per paper in natural sciences has risen in the last decade and it can be considered as an indicator of cooperation among authors driven by the challenge to do big science or due to the interdisciplinary character of research in some fields of science [3]. In order to verify whether agricultural sciences also follow the rising trends in collaboration activity or not, a case study of the publications of one of the primary institution, i.e. the Sugarcane Breeding Institute, Coimbatore (SBI) was undertaken. Cornell University, USA had conducted a survey of the cost benefit ratio in the agricultural institutions all over the world and the SBI was found ranking at the highest level with the lowest budget and the maximum benefit to the community [4].

METHODOLOGY

Publication from Sugarcane Breeding Institute, Coimbatore, in well established disciplines, viz. botany, genetic resources, breeding, genetics & cytogenetics, physiology & biochemistry, agricultural chemistry, agronomy & soil sciences, pathology and entomology during 1948-87, were considered. Number of authors, year of publication and content of publications were noted. One score was given for each author by observing its occurence [5]. The degree of collaboration in a discipline was defined as the ratio of the number of collaborative research papers to the total number of research papers published in a discipline during a certain period of time (6). It is expressed as:

$$CC = \frac{Nm}{Nm + Ns} \qquad \text{..........(1)}$$

where,

CC is the Collaboration Coefficient, i.e. degree of collaboration in the discipline,

Nm is the Number of multi-authored research papers in the discipline published during a year, Ns is the Number of single-authored research papers in the discipline published during the same year. The average authorship per paper (AAP) was calculated using the following formula:

$$(AAP)=\frac{\sum_i W_i\ P_i}{\sum_i P_i} \qquad \text{..............(2)}$$

Where W_i is the number of authors contributing to the i th Category (i = 1,2,3,4), P_i is the total number of papers in the i th Category. In order to study the association, a linear relationship has been assumed between CC and AAP, with CC as dependent and AAP as independent variable. The relationship is shown mathematically as:

$$(CC) = a+b\,(AAP) \qquad \text{.............(3)}$$

Where a and b are the constants to be estimated from the observed data.

The Coefficient of Determination (r^2 %) between (CC) and (AAP) for each discipline has been calculated using the following formula.

$$r2(\%) = \frac{[\sum_i (CC)_i\,(AAP)_i]^2}{\sum_i (CC_i)^2 \sum_i (AAP_i)^2} \times 100 \ \text{.............(4)}$$

RESULTS AND DISCUSSION

The Collaboration Coefficient (CC) and the Average Authorship per Paper (AAP) in a decade for each discipline were worked-out and are given in Table 1. It was found that among various disciplines, agricultural chemistry had the highest average Collaboration Coefficient followed by agronomy & soil sciences. Entomology had the lowest average Collaboration Cofficient. It was also observed that in most of the disciplines CC increased steadily over decades. This was a healthy and positive sign noticed in sugarcane research programme. Similar trend was seen in Average Authorship per Paper, where the average number of collaborators was found around two for all the disciplines. Based on the classification of the disciplines, viz. sugarcane improvement, sugarcane production and sugarcane protection, a good collaborative research was noticed in sugarcane production followed by sugarcane improvement. On the other hand less collaborative tendency was seen in entomology during 1948-67. An analysis was also undertaken to know the relationship between CC and AAP. A linear relationship has been tried with the help of the equation 3 given above based on the decade-wise data (1948-87). The values of the coefficient of determination (r^2 %) for each discipline using the formula (4) are given in Table 1 (Appendix 1). It was seen that the value of r^2 varied considerably from 0.02 to 76.84 among the disciplines. In other words, the relationship between number of authorship per paper and the Collaboration Coefficient was not of uniform order among the disciplines. CC had good linear relationship with AAP in genetics & cytogenetics, physiology & biochemistry and also to some extent in entomology, pathology and breeding. It was interesting to note that the relationship was in positive direction of collaboration for all the disciplines though varied considerably in magnitudes.

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APPENDIX 1

Table 1.

Discipline-wise Collaboration Coefficient (CC) and Average Authorships Per Paper (AAP) Over Four Decades

Period	1948-1957		1958-1967		1968-1977		1978-1987		Average		(r^2 %)
Disciplines	CC	AAP	CC	AAP	CC	AAP	CC	AAP	CC	AAP	
Sugarcane Improvement											
Botany	0.60	1.7	0.61	2.05	0.86	2.29	--	--	0.69	2.17	3.17
Genetic Resources	--	--	0.83	1.75	0.50	2.00	0.79	2.54	0.71	2.09	0.02
Breeding	0.66	1.85	0.71	2.08	0.64	2.13	0.74	2.31	0.69	2.09	38.51
Genetics & Cytogenetics	0.39	1.39	0.52	1.77	0.52	1.77	0.78	1.93	0.55	1.72	76.84
Sugarcane Production											
Physiology & Biochemistry	0.55	1.82	0.50	1.60	0.45	1.67	0.87	2.12	0.59	1.80	50.75
Agricultural Chemistry	1.00	2.00	1.00	2.18	0.77	2.31	0.85	2.33	0.91	2.12	20.25
Agronomy & Soil Science	1.00	0.50	1.00	3.00	0.80	2.46	0.62	2.04	0.86	2.00	28.66
Sugarcane Protection											
Pathology	0.57	1.50	0.50	1.56	0.51	1.62	0.73	2.33	0.58	2.01	30.05
Entomology	0.19	1.15	0.34	1.38	0.70	1.87	0.77	2.36	0.50	1.69	47.56

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RECENT INFORMATION TECHNOLOGIES AND THEIR IMPACT ON DISSEMINATION OF INFORMATION

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INTRODUCTION

Developments in computers and communication technology have revolutionized the modes and methods of information storage and retrieval. The advent of the digital computers, advances in the telecommunications and audio-visual technologies have opened up new possibilities in dealing with the problems of collecting, organising and disseminating a vast amount of scientific and technical information [1]. Now, information can not only be stored, retrieved, communicated and broadcasted electronically in enormous quantities and at phenomenal speeds, but it can also be rearranged, selected, marshalled and transformed. Any sequence of operations on information can be carried out without further human intervention or supervision.

Dramatic reductions in the size and cost of computer components and equally impressive gains in the speed, storage capacity and reliability of hardware components has expanded their use so rapidly that their presence can no longer be ignored. Today, everyone is compelled to understand capabilities, limitations and potential application of computers in their respective areas of specialization to cope up with the increasing demands of a modern society.

The use of computers for information storage and retrieval began with the production of computer generated and printed indexes for scientific and technical literature in late 1960. Subsequently, several organizations started using computers not only for generation and printing of indexes but also for creation of factual and textual databases containing full-length documents. By early 1970s, several published indexing and abstracting journals, such as Biological Abstracts, Chemical Abstracts, Index Medicus, etc. were not only produced by the computer but they were also made available as computer readable databases on magnetic tapes. Several organisations started subscribing them on magnetic media to organize local Information storage and retrieval services.

By mid-1970s [2], several organisations, including National Library of Medicine (US) and Systems Development Corporation (SDC)) had started offering online searches, from remote terminals from a variety of machine-readable indexing and abstracting databases. The development of optical disk technology, particularly Compact Disk (CD-ROM), which allows holding of huge quantities of digitized information and its local access, provides viable alternative to online searching. Several indexing and abstracting services as well as factual and textual databases are now available on compact disks.

MICROPROCESSOR TECHNOLOGY

Notable reductions in the size of microprocessor combined with dramatically enhanced capability has added new dimensions to the computer hardware technology [3]. The initial small silicon chips contained only a few components and circuits, but the average number of chip components has doubled each year since 1965 [4]. Early small-scale integration efforts first gave way to large-scale integration (LSI) chips that contained thousands of components. Now, very-large-scale integration (VLSI) chips contain hundreds of thousands of elements and ultra-large-scale integration (ULSI) chips with millions of components are also going to be available in near future.

Microcomputers or PC's are small general-purpose symbol manipulators that can be programmed to process a countless number of applications. The first microprocessor was produced on a single chip of silicon in 1971 and the earlier PCs were built around microprocessors chips that could operate on 8 bits of data at a time. All 8 bit microcomputers use a few standard microprocessors chip designs. Some eight-line data path chips are - Zilog's z80, MOS Technology's 6502, Intels 8080/8085 and Motorola's 6809. A 16 line address bus was later built into these chips (e.g. Intel's 80186 and 80286). 32-bit microprocessors (e.g. Motorola's MC68020, Intel's 80386 and Zilog's iAPX-432) developed in late 1980s, provide minicomputer capability at microcomputer prices. Intel's new 80486 microprocessor chip (32 bit architecture) is two to three times faster than the 386 and is fully compatible with the 386 family. The 486 supports large-scale data processing and number crunching applications as VAX machines.

OPTICAL STORAGE DISKS

CD-ROM (Compact Disk Read Only Memory) [5] remains the most exciting development in disk storage media since the introduction of Winchester technology. CD-ROMs are compact disks containing permanent, digitally encoded information on a vast scale, which is almost perfect in terms of accuracy. Optical storage media [6] score over magnetic media of storage as the former allows handling of huge quantities of digitized information. Moreover CD-ROMs eliminate the problems of differential hours and telecommunication charges.

A single silvery plastic disk or "platter", as it is more commonly called, stores 600 MB of data which is equivalent to 1000 floppies approximately or 3,00,000 pages of text [7]. The CD-ROM uses the same metal coated, plastic platters called macrolon as used for digital audio recordings. The digital information is burned into macrolon by a laser. An aluminium layer and plastic acrylic layer is added to the disk's surface in a vaccuum chamber to increase reflectivity and protection. The reflected laser beam from the shiny surface of a compact disk is read by a CD-ROM player or laser disc player. The compact disks are rugged against environment and temperature changes. They are also heat, water and dust resistant.

Many databases, which were earlier available only through online vendors or as conventional abstracting and indexing services are now available on CD-ROM. The databases on CD-ROM, contrary to online searching, offer more freedom to the user in formulating search strategy and in conducting experimental searches with different search strategies.

NON-CONVENTIONAL ONLINE INPUT DEVICES

Communication with computers has evolved from the use of machine codes and punched cards to a more direct and convenient method of communication. Keyboard entry of data is now the main method of input. Recent developments permit the computer to "read" typed (and even hand-written) symbols directly, via Optical Mark Reading (OMR), Magnetic Ink Character Recognition (MICR) and Optical Character Recongnition (OCR) devices. More recently developed devices [9] include Scanner, Mouse, Light pen, BAR code readers : line / bars arranged in a code for lable, Hand-held terminals, Track-ball, Tablet, Control dial model, Button box, Touch screen, Joy sticks and Audio response unit / Audio synthesizer.

COMPUTER OUTPUT MICROFILM (COM) / COMPUTER INPUT MICROFILM (CIM)

A COM device translates information stored on magnetic media into miniature images on microfilm, using photographic methods. The microfilm can be read / printed using a microform reader printer. COM device works 25-30 times faster than the average line printers and the cost of microfilming is much less as compared to the total stationery required otherwise.

A COM system has ideal application where there is a large amount of low-assessed information. Services of microfilming bureau offering a COM processing services can be hired by the users of small-sized computers.

CIM systems are comparatively new area of development. A CIM system retrieves the relevant roll of film from its film library, selects the correct frame, digitise the document stored on the frame and displays the image on the screen. CIM developments make use of optical disk technology using enormous capacity that these devices offer.

OFF-THE SHELF APPLICATION PACKAGES

Several ready to use application packages [10] are now available in the market which are addressed to specific data processing task. Some prewritten application packages perform single function such as word processing or analyzing rows and columns of data while other packages integrate several functions in a single module. Single function application packages can be broadly categorized as word processing packages, Spreadsheet programmes, graphic packages, desk top publishing packages, database management system (DBMS), management information system and data communication packages. Integrated-function application packages include packages like LIBSYS, CDS/ISIS / MINISIS, etc.

SINGLE FUNCTION APPLICATION PACKAGES

Word Processor

Several standard word processing packages developed in various languages are in use currently. A word processing package is a software program designed to run on specific types of computers to create, view, edit, manipulate, transmit, store, retrieve and print text material. It may also incorporate an online dictionary or a thesaurus and program for checking and correcting the spellings in a given text. Today's word processing packages provide several advanced features and are quite comparable to "desk-top publishing packages". Some of the popular packages are Wordstar (ver. 4 & 5 & 2000), Wordsoft, etc.

Spreadsheet

Spreadsheets are the packages designed to handle statistical analysis on data values fed in columns and rows of its worksheets. A user can perform calculations, plot graphs and other operations on these data. Spreadsheet packages also provide elementary features of database management packages. Lotus-1-2-3, SPPSS, Super Calc are some of the examples of Spreadsheet / statistical analysis packages.

Graphics Package

Graphics packages are the software products that convert the numeric data into the pictures that convey patterns and trends better than rows and columns of data. Graphics packages are available for designing, painting, analysing and presentation of data. Design packages are used to improve the productivity of designers, architects and engineers. Computer-aided design (CAD) techniques are used in countless ways to automate the design and drafting process. Analysis packages use bar,pie,line and other types of charts to summarize columns and rows of the data in graphs and pictures. Presentation packages are used to communicate messages to an audience. They have all the features of an analysis package and also allows the user to create three-dimentional drawings and dress up the images in many other ways.

Desktop Publishing

Desktop publishing (DTP) systems are combination of computer software package, scanner and laser printer. A DTP package can produce attractive page layouts complete with pictures and text in a variety of typefaces. The package includes a page layout program that allows users to format pages and merge text and pictures on their display screens. Some desktop publishing systems are dedicated units that are built around powerful engineering workstations, while others are PC-based systems that run off-the-shelf desktop publishing packages.

Database Management System

DBMS permits people to search and query database contents to extract answers to unplanned questions that are not available in regular reports. It allows user to define his own data items and place them in specified records, combine these records into designated files and then manipulate and retrieve the stored data in various ways to achieve the defined goals. It is the most popular of all the available application packages. The reasons for the popularity of databases are sophisticated programs, improved processor and larger storage capacity that permits users to handle more records. RAM and hard disks improve processing speeds. The gain in storage and speed enables users to create larger databases than were possible with the older programs. Database management packages are usually classified into file management, relational, hierarchical and network categories.

Management Information System

MIS [11] gives its users a direct online path into the organisation's databases to retrieve the facts they need. An MIS is a network of computerized data processing procedures and computer-accessible databases that are developed in an organisation and integrated as necessary with manual records and procedures to provide timely and effective information support for decision making and other necessary management functions. A number of sub-systems are included in an Information system. The first component to be included under the banner of Management Information System (MIS) is operational/tactical support systems that process translations, produce reports and answer expected enquiries. A decision support system (DSS) that helps managers extract essential data from other systems and then apply data analysis and decision procedures to the retrieved data to make unstructured decisions is another MIS component. An automated office system is a third component found in many MISs. An MIS master plan is generally drawn up with these systems so that human technological resources are used in ways that best support the strategies, goals and processors of the firms.

Data Communications

DC package is a software that allows a user to send and receive data over communication lines. A modem is needed if computer output is to be accepted and transmitted on conventional telephone lines. Communication packages support electronic mail/message systems. The electronic mail systems are used to accept, store and distribute keyed messages to specified recipients.

INTEGRATED-FUNCTION APPLICATIONS PACKAGES

Integrated Application pacakages combine several of these general purpose functions in a single product. Most or all of the following functions are included - word processing, manipulating spreadsheets, managing files or databases, sending communications, preparing graphics and creating outlines. Integrated packages provide facility to use a common set of instructions to share data and more material among several applications.

The integration of a variety of functions into the computer-based information system is an attractive concept. But several information centres in India, are using only single function DBMS packages like CDS-ISIS/MINISIS or self developed packages. LIBSYS software package, developed in India, is an integrated library management system.

EXPERT SYSTEMS

An expert system [11] consists of a stored base of knowledge in a specialised area, and an expert system shell that is able to probe this knowledge-base and make decisions and recommendations. The new concept of expert systems, as a high level intellectual support for the human experts has evolved as an innovation in the man-machine interfaces. Expert systems are products of years of research in artificial intelligence which aims at probing applicaton of computers in performing tasks that involves intellectual, communications and sensory activities akin to those in human being. One of the first expert systems developed, is DENTRAL which manipulates and analyses data on mass spectroscopy. Other popular expert systems include MYCIN for medical diagnosis, CRIB for computer aided diagnosis and NEXPERT for development of softwares. LISP and PROLOG are two AI languages, that are used to write expert systems programme.

ONLINE DATABASES

The idea of sharing information has given way to the concept of online databases. A database is a non-redundant, multi-usable, independent and physically available set of data elements, stored in an organised and structured manner to allow user to search the information in an interactive mode.

The earlier databases were bibliographic in nature and were online versions of existing indexing and abstracting services such as Biological Abstracts, Index Medicus, Chemical Abstracts, etc. By 1986, only half of the available databases were bibliograhic. A number of online databases containing textual information like news, statistics, commodity prices, etc., were introduced. Another type of databases holding full-length documents also started appearing. Several databases of full text of encyclopedias, directories and articles from selected journals are now available online.

The number of bibliographic databases for public searching is growing every year. Databases are now increasingly appearing on Compact discs (CD-ROM). Approximately 800 databases on CD-ROM are now available for subscription. ADONIS (Article Delivery Over Network Information Systems) project, a landmark in electronic publishing, is launched by a consortium of five major publishers - Academic Press, Blackwell's Scientific Publications, Elsevier Science Publications, Pergamon Press and Springer Verlag. The project uses combination of laser scanning, printing and digital optical storage technology for storing articles from over 400 scientific, technical and medical journals. These journals would be available on CD-ROM with weekly updates for distribution to selected libraries, which will be licensed to use the system for document delivery.

INTERNAL ONLINE SEARCH SERVICES

Online search services offer a number of databases to the users for online access through telecommunication links. A user can directly access the databases residing on the host computer from a computer terminal using a communication package and communication links in two-way interactive mode. These databases are hired / leased to the online search services (also called vendors, spinners or retailers) from their owners (i.e. information providers-often the publishers of the printed versions of databases). There are more than 500 hosts offering online search services. Some of these hosts are "Umbrella" or "Supermarkets" type covering all fields, while the others offer only their own databases. Some of the important online bibliographic search services include : DIALOG [12], ORBIT, BRS and Datastar in USA; BLAISE and Pergamon Infoline in UK; DIMDI in Germany; Euronet and Diana in Europe; ESA-IRS in Italy; and CAN / OLE in Canada.

DATA COMMUNICATION AND TELECOMMUNICATION NETWORKS

Communication channels [13] are used for data transfer from minis or mainframe computers to the terminals and vise versa. Data communication [14] refers to the means, modes and methods of data flow between central processing systems and online data processing location or between a micro computer and an online search service. The data communication links permit a direct interactive bond between the remote terminals and the central processing systems.

Telecommunication networks are now available to handle voice, digitized data and video / visual images for information recognition, processing and retrieval. The technologies are essentially different for handling the three different methods of information transfer, but it is not uncommon for a network to combine all the three modes of communication.

The existing telecommunication networks [15] can be classified into common carrier, specialized common carrier or value-added carriers. Common carriers are the most common large public switched telephone and telegraphs networks (PSTN) and accounts for most of today's network transfer. Specialized common carriers are specially designed for data transmission and often use broadband facilities such as microwave / satellite systems. Common carriers for data communication rely on packet switching technique and are called Packet Switched Data Networks (PSDN).

Value-added carriers generally use the telephone lines and data transmission facilities of other specialized carriers. The first value-added data networks such as Tymnet and Telenet started operating in early seventies. Both the carriers now have nodes all over the world. In India, Videsh Sanchar Nigam (VSNL), Delhi & Bombay has commissioned the International Gateway Packet Switching System (GPSS) [16] in Nov. 1988. The GPSS provides access to several international PSDNs. It can be accessed over the Public Switched Telephone Networks (PSTN) by a call to PAD (Packet Assemblers / Dissemblers) installed at VSNL in Delhi and Bombay.

VIDEOTEX

Videotex [17] is an electronic system which use a VDU to present computer-based information in a user-accessible visual form. Videotex systems use telephone lines or other channels of communication that provide a two-way link, known as viewdata systems, whereas videotex systems in which information is broadcast to the terminals are known as broadcast videotex or teletex systems. Use of ISDN for videotex allows rapid connection and data transmission speed. This results in picture generation at a terminal in fraction of the time taken by conventional networks and hence offers a reduction in response time and cost.

TELETEXT

Teletext system is a sequence of numbered information pages, or screenful of information, broadcast cyclically over a television channel. The user may chose for required page using a teletex decoder. ISDN teletex sets up connections very rapidly and then transmits data many times faster than telex.

FACSIMILE TRANSMISSION

Facsimile (FAX) is a new service for transmission of data. This enables the user to transmit the entire document faithfully to the other end. This facility is permitted on all existing telephone lines. It is permitted on the private leased telephone circuits also. The FAX equipment at the calling and called end should be compatible with each other in all respect.

CONCLUSION

Microcomputers are increasingly used for storing, reorganizing and disseminating information. The developments in telecommunications and microcomputer technology has taken a quantum leap. In India, the relavant technologies are being acquired from developing countries under the policy of the Government of India in the required areas. The level of expertise, competence and knowledge in the field of computer communication and networking software has increased sufficiently to effect various methods of communication within and outside India. Commissioning of International Gateway Packet System (GPSS) at VSNL, New Delhi and Bombay has facilitated cheaper and easier communication with online search services. Over 4,000 databases are available now for online access through communication networks. Moreover, in-house use of databases on CD-ROM has even eliminated the cost involved in accessing the databases with commercial vendors. Availability of knowledge gateways like "EASYNET", facilitates online searches over a number of databases and online search services without knowing the structure of these databases or protocols of the search services involved. Moreover, online search services now offer improved search facilities specially to inexperienced users. DIALOG, for example, offers "DIALOG Medical Connection" which, in turn, allow searching a number of databases in one go without having to know structure of those databases. Further, outputs from these databases can be merged and reorganized after deleting duplicate entries. The progress being made in computer, communication and software technology is offering better products and services every day which, in turn, helps in improving the information processing and management needs. The developments promise direct interaction between the users and information banks eliminating the need of intermediatory or information brokers. The intermediatories including librarians and information scientists should channelize their resources to promote the direct interaction between the users and information banks.

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APPLICATION OF BIOTECHNOLOGY IN MASS HEALTH CARE - LITERATURE TREND

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Analysis of 3199 references collected in the area of "Mass Health Care" published in the Derwent Biotechnology Abstracts during the years 1983-87 reveals that the research work carried out in the area of antibiotics is substantially more than that done on other pharmaceutical products. Researchers from Japan have contributed about 35% of the total literature followed by USA (25.4%). The private companies are playing a significant role in such type of research. A rank list of cited journals indicates that 70% of the literature is scattered in 55 journals. The study may be useful for Indian scientists to enhance research in selected areas of pharmaceuticals.

INTRODUCTION

Biotechnology has emerged as a technological revolution that has influenced almost every sector of human activity, the most important of these being human and animal health care. A number of new products available now seem to promise health care for everyone. The greatest hurdle to fulfill this promise may be the cost of such products. Application of the processes based on bio-engineering principles in production of these products enable mass production at affordable prices. One of the main characteristic features in the development of biotechnology appears to be its dependence on diverse scientific and engineering disciplines and therefore, the information sources to be consulted are also diverse.

OBJECTIVES

The objectives of the study are as follows:

1) to determine the number of articles published in specific journals with the assumption that a few journal titles would carry many, if not most, of the articles.
2) to find out the research institutions/ private companies engaged in conducting the research in different fields of pharmaceuticals.

METHODOLOGY

The study is based on the bibliographical data collected from the Derwent Biotechnology Abstracts published by Derwent Publications Ltd., London, in the area of biotechnology applications in mass health care for the period of 1983-87 and consists of journals, patents, conference papers/abstracts, etc. The analysis of the resource literature is made on following aspects.

a) Country-wise distribution of literature.
b) Productive institutions in different countries.
c) Identification of core journals in pharmaceuticals.
d) Distribution of literature by type of documents.
e) Chronological distribution of literature.

LITERATURE TREND - AN ANALYSIS

The countries like Japan, USA, USSR, Canada and India are taken individually for the analysis of the production aspect of pharmaceutical literature. The European countries (UK, France, Germany, Belgium, Sweden, Switzerland, Spain, Czechoslovakia, Netherlands) are considered together for the purpose. The countries which are having less then 20 references are not included in the study.

Table 1 shows the country-wise distribution of Pharaceutical literature. Japan produces maximum literature, i.e. 34.41% followed by the European Countries' USA, USSR, Canada and India with 26.50%, 25.37%, 4.26%, 1.64% and 1.37% respectively. Japan and European

Table 1
Country-wise Distribution of Pharmaceutical Literature

Country	No. of Entries	Percentage	Cum%
Japan	1153	34.41	34.41
European Countries	888	26.50	60.91
USA	850	25.37	86.28
USSR	143	4.26	90.54
Canada	55	1.64	92.18
India	46	1.37	93.51
Others	251	6.46	99.97

Table 2
Institution-wise Distribution of Pharmaceutical Literature in Various Countries

Country	Institution	No. of Entries
USA	Merck and Company Inc.	19
USA	Eli Lilly and Co.	15
USA	Genetech Co.	11
USA	U P John and Co.	10
USA	Squibb & Sons Inc.	10
JAPAN	Kitasato University	23
JAPAN	University of Tokyo	22
JAPAN	Kyoto University	21
JAPAN	Institute Chemical Industry	20
JAPAN	Takeda Chemical Industry	19
UK	Wellcome Group	10
UK	AFRC Institute of Food Research	7
UK	University of Oxford	7
UK	University of Leeds	7
UK	University	4
USSR	M V Lomonov Moscow State University	12
USSR	All Union Res. Inst. Of Antibiotics	11
USSR	All Union Scientific Res. Inst. of Antibiotics	9
USSR	Ivanovsk Inst. of Virology	7
USSR	A N Bakh Inst. of Biochemistry	6
FRANCE	Inst. Pasteur	14
FRANCE	Faculte De Pharmacie	5
FRANCE	Laboratoire De chimie organique Biologique	5
WEST GERMANY	Ges. Biotechnol. Forsch	10
WEST GERMANY	Zentral Institute fuer Mikrobiologieund experimentelle Therapie der Adw	9
WEST GERMANY	Institute fuer Mikrobiologie, Universitaet Muenster	7
WEST GERMANY	Bayer	4
INDIA	Bose Institute Calcutta (Dep of Microbialogy)	4
INDIA	Regional Research Lab. Jammu	4
INDIA	Hindustan Antibiotics	3
INDIA	Indian Institute of Science	3

Table 3

Patents from Various Countries

Country	Patents	No. of Patents
USA	Lilly	45
USA	Genetech	16
USA	UP John	15
USA	Roche	14
USA	Chiron	10
USA	Merck and CO.	10
JAPAN	Takeda	41
JAPAN	Kyowa Hakko	35
JAPAN	Ajinomoto	34
JAPAN	Green Cross	20
JAPAN	Suntory	15
JAPAN	Meiji	14
JAPAN	Agency Ind. Science	14
UK	Technical Licence	15
UK	Beecham	10
UK	Lepetit	9
UK	Glaxo	8
UK	Cell tech	6
UK	CPC Intrim	6
WEST GERMANY	Hoechst	17
WEST GERMANY	Bayer	10
WEST GERMANY	Behring Werke	5
WEST GERMANY	Ges. Biotechnol Forsch	5
WEST GERMANY	Cons Elektrochem Ind.	5
FRANCE	Inst. Pasteur CNRS	10
FRANCE	Transgene	5
FRANCE	Dick P R	4
FRANCE	Genetica	4
FRANCE	INSERM	3

P, 5735

Table 4

List of Core Journals in Pharmaceuticals (1983-1987)

Sl. No.	Rank	Name of the Journal	Country	Frequency	Total No. of Articles	%	Cum.%
1.	1	J Antibiot	Japan	12	169	13.23	13.23
2.	2	Agric Biol Chem	Japan	12	47	3.68	16.91
3.	3	Antibiot Med Bio-Technology	-	-	36	2.81	19.72
4.	4	Biotechnology Bioeng	USA	12	35	2.74	22.46
5.	5	Gene	Netherlands	30	32	2.50	24.96
6.	5	Appl. Microbiol Biotechnology	USA	12	32	2.50	27.46
7.	6	Proc Nat Acad Sci USA	USA	12	29	2.27	29.73
8.	7	Biotechnology Lett	UK	12	26	2.03	31.76
9.	8	Nature	UK	52	25	1.95	33.71
10.	9	Appl Environ Microbiol	USA	12	23	1.80	35.51
11.	10	J Gen Microbiol	UK	12	22	1.72	37.23
12.	11	Bio/Technology	UK	12	19	1.48	38.71
13.	11	Trends Biotechnol	Netherlands	12	19	1.48	40.19
14.	12	Plant Med	F R G	06	18	1.40	41.59
15.	13	J Immunol	USA	12	15	1.17	42.76
16.	14	Tetrahedron Lett	UK	52	14	1.09	43.85
17.	14	Infect Immunol	USA	12	14	1.09	44.94
18.	15	F E M S Microbiol Lett	Netherlands	12	13	1.01	45.95
19.	16	J Ferment Technol	Japan	06	12	0.93	46.88
20.	16	Biochem Biophys Res Commun	USA	24	12	0.93	47.81
21.	16	J Interferon Res	USA	04	12	0.93	48.74
22.	17	Biofutur	France	12	11	0.86	49.60
23.	17	J Virol	USA	12	11	0.86	50.46
24.	17	J Biotechnol	Netherlands	12	11	0.86	51.32
25.	17	J Biol Chem	USA	24	11	0.86	52.18
26.	17	Plant Tissue Culture	-	-	11	0.86	53.04
27.	17	Ann N Y Acad Sci	USA	-	11	0.86	53.68
28.	18	Science	USA	52	10	0.78	54.68
29.	18	Anal Biochem	USA	18	10	0.78	55.46
30.	18	Current Science	India	24	10	0.78	56.24
31	18	Chem Pharm Bull	-	-	10	0.78	57.02

Table 5

Distribution of Literature by the Type of Documents

Type of Documents	No. of Entries	%	Cum %
Journal Articles	1277	38.12	38.12
Patents	1614	48.27	86.39
Conf. Papers	452	13.49	99.88
Advances	07	00.21	100.00

Table 6

Distribution of Literature by Country and Type of Documents

Country	Total No. of Jl. Articles	Patents	Conf. Papers
Japan	286	845	22
European Coun-tries	386	309	191
USA	335	346	164
USSR	92	29	22
Canada	39	02	14
India	44	-	02
Others	95	83	37

Table 7

Year-wise Distribution of Literature is Various Countries

Country	1983	1984	1985	1986	1987
Japan	196	160	292	224	281
USA	87	112	222	219	210
European Countries	94	67	205	219	303
USSR	26	16	21	31	49
Canada	09	04	12	11	19
India	10	06	11	09	10
Others	29	30	44	54	58

Table 8

Country-wise Distribution of Literature of Products

Country	a	b	c	d	e	f	g	h
Japan	397	48	88	50	14	36	3	430
USA	248	149	59	148	7	20	15	145
European Countries	257	124	63	149	25	20	7	171
USSR	61	4	11	13	50	8	1	24
Canada	25	8	1	4	-	-	1	9
India	13	1	1	8	3	3	-	16
Others	45	38	36	39	11	8	4	30

a is Antibiotics,
b is Hormones/Regulatory proteins/Growth Factor/Monoclonal antibodies,
c is Interferons,
d is Vaccines,
e is Microbial transformations,
f is enzymes,
g is Diagnostic product,
h is Miscellaneous product.

countries contribute most of the literature (60%), where as the other western countries contribute 40%, India contributes about 1.50%. Pharmoceutical literature produced by various countries is tabulated in Table 2 and 3. The study included 1277 titles. First 55 core titles reported 70% of literature. However, a list consisting of 31 titles having more than 10 citations each is tabulated in Table 4 which may be useful for the libraries and scientists for selection of journals. The first 23 journals cover 50%, the next 32 journals cover 20% and the rest 1222 journals cover only 30% of the total literature.

A detailed analysis of the present list shows that a large number of journals occupying first few positions are devoted not only to the pharmaceuticals but also to the highly specialised disciplines like antibiotics, microbiology, biotechnology, biology, etc.

The study revelas that a large number of journals are published from USA and UK followed by Netherlands, USSR, Japan, India, West Germany, France, Switzerland and Czechoslovakia. However, 31% of the first 55 journals are published from USA and only 18% from UK. The number of journals published from Japan is less but they cover 17% of citations. The distribution of literature by type of documents is shown in Table 5. From the table it could be seen that the number of the patents filed are comparatively higher than the number of journal articles, conference papers and advances. Literature in advances is observed to be very low. Table 6 Shows the distribution of documents by country and type of documents. USA publishes the highest number of journal articles followed by European countries, Japan, USSR, etc. India countributes only 3.44%. European countries, USA, Japan countribute more than 50% of the journal articles. Japan dominates in the filing of patents followed by USA and European countries. About 53% of the patents were filed by Japan where as 47% were filed by the rest of the countries. Conference papers/abstracts output is also shown in table 6. Most of the literature in this category is contributed by USA (36.28%). Table 7 shows that the number of references (Published Literature) covered in the year of 1983 in "Derwent Biotechnology Abstracts" are 451 whereas in 1987 the number is 930, i.e. it is increased by 479. The research work in health care (Pharmaceuticals) is shown to be increasing. Table 8 shows that Japan is the major contributor in antibiotics followed by the European Countries, USA, USSR, Canada and India. In the area of hormones/regulatory protiens/ monoclonal antibodies, USA is leading followed by European countries and Japan. Japan, USA and the European countries are doing maximum research of interferons and vaccines as compared to other countries. The research work on production of enzymes, microbial transformations, and diagonostics is comparatively less than that is other areas of pharmaceuticals. Special attention is needed to the manufacturing of these products. An overview of the table shows that Japan and USA are the main productive countries of pharmaceutical products. It also revelas that approxmately 60% of the literature is devoted to antibiotics, vaccines, hormones and interferons.

CONCLUSIONS

A critical analysis of the literature collected in the area of'mass health care' reveals the following:

1) In the country-wise distribution of literature, Japan tops the list (34.4%), followed by the U.S.A. (25.4%). India's contribution in this area is only 1.37%.

2) Private Companies/R & D institutions are observed to play a significant role in the generation of literature/data (including patents), in almost all the countries. This trend, however, does not seem to be valid for Indian organisations.

3) A list of 31 core journals which carry a large portion of the literature (70%) may provide a helpful guide for institutions/R & D teams to select the journals of their interest.

4) Most of the literature from India appeared as papers in journals and only 4.3% literature was cited as conference papers.

5) There is a fast growing trend in production of literature every year almost in all countries, except India, where the number has remained almost constant during the period of study (1983-87).

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ARE THE JCR IMPACT FACTORS OF INDIAN S&T JOURNALS RELIABLE?

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Though SCI includes about 3000 S&T journals in its database every year, it does not show a good coverage of journals from the developing countries. In 1988 only 11 Indian journals were covered in SCI. This figure varies from year to year. The present study shows that the impact factors of Indian journals obtained from JCR are probably not true reflections of the quality of Indian journals.

INTRODUCTION

Ever since the advent of Journal Citation Report (JCR) in 1975., the impact factors (IF) of some of the Indian journals are available from the aforesaid publication every year. By and large, the IF of only 40 journals have been provided during the past few years [1] [Table 1]. Of these journals, only about a dozen titles are being covered by SCI [* marked items in Table 1].

DEFINITION

Impact Factor

The impact factor (IF) of a journal J for the calendar year Y can be mathematically represented as

$$IF(J_y) = \frac{x_1 + x_2}{y_1 + y_2} \quad \text{.................} \quad (1)$$

where

$IF(J_y)$ = impact factor of the journal J for the calendar year Y
x_1 = number of citations received by y_1 source items in Y calendar year
x_2 = number of citations recieved by y_2 source items in Y calendar year
y_1 = number of source items published in journal J in (Y-2) calendar year
y_2 = number of source items published in journal J in (Y-1) calendar year

It is to be noted that the values of x_1 and x_2 are database specific, and are likely to change with the change in the database.

A journal, generally, receives citations from the journals from all over the world. Journals emanating from the developing countries are mostly local journals in the sense that they are likely to be cited less by journals emanating from other countries. Anyway, taking it for granted that the journal J will be cited by two categories of journals, i.e.

a) journals emanating from the country of its origin and
b) the journals emanating from other countries.

Eqn.(1) can now be represented as:

$$IF(J_y) = \frac{x_n + x_f}{y_1 + y_2} \quad \text{..................} \quad (2)$$

Where

x_n : number of citations received by the journal J in the year Y in its source items $y_1 + y_2$ from the journals of its own country
x_f : number of citations received by the journal J in year Y in its source items $y_1 + y_2$ from the foreign journals

Now, for an Indian journal, the value of x_f for a year is constant in SCI database (this is true for any non-US journals). But the value of x_n is dependent on the number of Indian journals covered in SCI database. With the addition of more Indian journals in SCI database, the value of x_f should logically go up. The present study addresses itself to this very hypothesis.

OBJECTIVES

The study is conducted with the objective whether the notional inclusion of non-SCI Indian journals in a related field has any impact on the IF of

a) The Indian journals being studied and
b) The foreign journals, figuring in SCI database.

If so, to what extent does it affect the Indian and the non-Indian journals.

MEHODOLOGY

It was decided that journals belonging to four broad areas, i.e. agriculture, chemistry, medicine and physics would be studied and accordingly, the top ranking Indian journals based on IF of 1987 would be identified in each field.

Two top ranking non- Indian journals of the same year would also be covered pertaining to each of the above fields. The list of journals arrived at according to the aforesaid criteria is as follows (obviously, these journals can be termed as cited journals):

Table 1
Impact Factor of Indian S&T Journals Provided in 1988 JCR

Journal	Impact Factor
Ann Arid Zone	.000
Bull Mater Sci	.265
Colourage	.006
Comp Physiol Ecol	.060
*Curr Sci	.164
Entomon	.025
Indian J agric Res	.000
Indian J agric Sci	.011
Indian J Agron	.000
Indian J Anim Sci	.014
Indian J Biochem Biophys	.214
*Indian J Chem - A	.314
*Indian J Chem - B	.281
Indian J exp Biol	.151
Indian J marine Sci	.072
*Indian J med Res	.204
Indian J pure appl Math	.064
Indian J pure appl Phys	.116
Indian J Radio Space Phys	.047
Indian J Technol	.130
Indian Vet J	.017
Int J trop Agric	.023
*J Astrophys Astronomy	.585
J adv Zool	.017
*J Biosci	.282
J envir Biol	.259
J Fd Sci Technol	.044
*J Genetics	.588
J geol Soc India	.144
J Indian chem Soc	.108

J Optics	.138
*J Sci ind Res	.248
Natl Acad Sci Lett	.033
*Pramana	.521
*Proc Indian Acad Sci - Anim Sci	.048
*Proc Indian Acad Sci - Chem Sci	.300
*Proc Indian Acad Sci - Earth Sci	.106
Proc Indian Acad Sci - Math Sci	.019
Proc Indian Acad Sci - Pl Sci	.036
Res Ind	.019
Sadhana	.055
Sankhya - A	.205
Sankhya - B	.159
Trans Indian Inst Metals	.020

* Covered by JCR 1988

Table 2

Journals Selected for the Study

	Indian Journals		Foreign Journals	
Subject	**Title**	**IF**	**Title**	**IF**
Agriculture	Indian J agric Sci	(.024)	Agron J	(.797)
			Aust J agric Res	(.816)
Chemistry	Indian J Chem A	(.245)	Angew Chemie Int Ed	(4.685)
			J Amer chem Soc	(4.318)
Medicine	Indian J med Res	(.265)	New England J Med	(19.318)
			British med J	(2.758)
Physics	Pramana	(.339)	Phys Lett B	(3.755)
			Usp Fiz Nauk	(3.118)

Three to four Indian journals belonging to each of the aforesaid fields were selected taking care that they were not covered by SCI. The journals thus selected are listed in Table 3. The purpose of selecting these journals was to find out to what extent they have cited the source items of their counterparts figuring in Table 2. Thus these journals are citing journals with respect to the journals in Table 2.

Having selected the citing journals in each field, each reference provided under every article published in 1987 in these journals were checked to count the citations to source items of 1985 & 1986 of the cited journals given in Table 2. The checking and counting were done strictly according to category. For example, citations of the journals belonging to agriculture figuring in Table 2 were checked only in the journals figuring under agriculture in Table 3. Citations, if any, were recorded for further analysis.

Table 4 shows the number of citations received by the cited journals under study from the citing journals listed in Table 3.

For the calculation of the impact factor, the equations reported earlier in this paper have been made use of.

From Table 4, it is clear that every Indian journal has received citations from the citing journals cosidered for the present study, and it does affect the IF as can be seen from Table 4. The effect is more on the Indian journals than on the non-Indian journals. It may be argued that the effect in the IF of the Indian journals is only marginal. At this point, it is to be remembered that only a few Indian journals are considered in each category and that too more or less randomly. For example in Agriculture, only 4 journals are considered whereas about 100 agricultural journals are being published in India. Similarly, in Medicine, the journals under consideration are only 3 whereas there are more than 150 journals in this field. Even if 50% of Indian agricultural & medical journals are covered it can be safely predicted that the IF of Indian journals would rise appreciably. This is likely to be true for countries like China and USSR as well.

CONCLUSION

The impact factor of Indian journals being obtained fron JCR is not the true reflection of the quality of Indian journals. The coverage of Indian periodicals in SCI being less, the real impact factors of Indian periodicals are not getting reflected.

Inclusion of a journal in SCI database requires fulfilment of several criteria like citation count, timeliness of publication, internationality in scope, peer judgement etc. [2]. Most Indian periodicals fail to fulfil these criteria. As such, they are excluded from SCI database. Exclusion of an Indian periodical from SCI database is likely to affect negatively the IF of other Indian journals being covered in SCI. More Indian periodicals may be considered for coverage in SCI database if they improve their standard to the level of SCI. With the coverage of more Indian journals in SCI, JCR will reflect the near real IF of Indian journals.

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Table 3
List of Citing Journals

Subject	Journal
Agriculture	PAU J Res J Indian Soc Soil Sci Indian J agric Res Indian J Agron
Chemistry	J Indian chem Soc Indian J appl Chem Chem Age India Acta Ciencia Indica - Chem
Medicine	Indian J med Sci Indian Practitioner J Indian med Assoc
Physics	Indian J Phys - A&B Proc Indian Natl Sci Acad - A Proc Natl Acad Sci - A

Table 4

No. of Citations Received by the Cited Journals

Subject	Journal	Source Items 1985-1986	Citations received by source item in 1987 (SCI)	Citations received by the source item from additional citing journals	% Increase in IF
Agriculture	Indian J agric Sci	411	11	1	12.5
	Agron J	413	329	-	-
	Aust J agric Res	141	115	-	-
Chemistry	Indian J Chem - A	694	172	2	1.224
	Angew Chemie Int Ed	692	3242	2	-
	J Amer chem Soc	3661	15812	4	.023
Medicine	Indian J med Res	453	123	3	2.641
	New England J Med	746	14423	12	.008
	British med J	1946	5365	15	.254
Physics	Pramana	298	111	10	9.730
	Phys Lett - B	2930	11013	11	.080
	Usp Fiz Nauki	119	371	-	-

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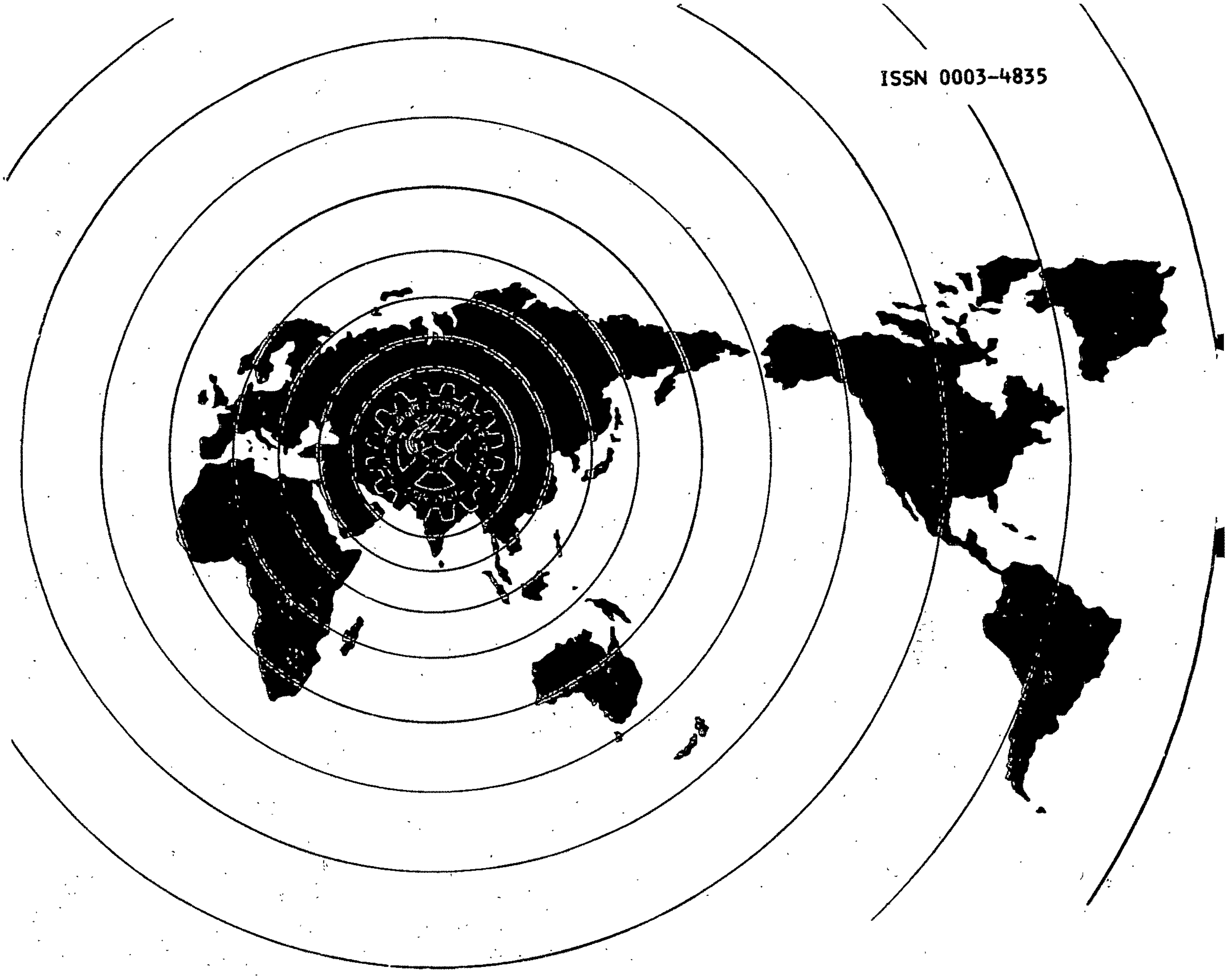

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IN THE EVERLASTING MEMORY OF Dr. S.R. RANGANATHAN,
THE FATHER OF INDIAN LIBRARIANSHIP, DOCUMENTATION
AND INFORMATION SCIENCE ON HIS BIRTH CENTENARY

EDITORIAL

LEGACY OF Dr. S.R. RANGANATHAN

Professional librarians, documentationists and information scientists can derive a legitimate pride in their goodfortune of being fellow countrymen of Dr. S. R. Ranganathan, whose birth centenary is being celebrated currently. It is often said that what Newton was to physics, Dr. Ranganathan was to library science. But Newton's efforts went only to extend the frontiers of a discipline already well established. On the other hand. Dr. Ranganathan's efforts helped to create a new discipline where none existed previously or existed only as a nebulous concept.

Dr. Ranganathan's contributions to library and information dissemination are unique and immense. He was a volcano of nascent thoughts and ideas. There is no field of library science which did not benefit from the impact of his personality. He gave the profession its celebrated five laws of library science. He is revered as the creator of Colon Classification. He provided new lead and insight into activities like facet analysis, chain indexing, canons of cataloguing, depth classification and so forth.

He was a prolific writer authoring over 50 works, 2000 papers and scores of library development plans including library legislations. As a teacher and educationist, he had few peers. No wonder that he is variously described as the 'Father of Library Science in India', 'Great Messiah of Library World' etc., even terms like prophet, seer, saint, etc., have been used for him by acknowledged leaders of world opinion from time to time. He richly deserves all this acclaim and accolade.

The Indian National Scientific Documentation Centre (INSDOC) had the good fortune of being associated with Dr. Ranganathan right from its inception in 1952 as the founder and the chairman of its first Advisory Committee. Dr. Ranganathan had made immense contribution in shaping the programmes and policies of INSDOC. His guidance was particularly useful to the Centre for overcoming its teething problems and getting its proper bearing and sense of direction during its formative years.

Building assidously upon the lead and guidelines provided by Dr. Ranganathan, INSDOC has steadily acquired a status where it is counted among the leading centres for information retrieval in various fields of science and technology.

The Annals of Library Science and Documentation, originally published as Annals of Library Science had also the unique distinction that its Founder Editor was none other than Dr. Ranganathan himself. He had conceived this journal in the nature of a medium in which the leading lights of the profession could share their ideas and views on various issues of topical interest. It was also meant to be a channel for publication of original research studies. It remains a matter of credit for us that in his life time, Dr. S. R. Ranganathan had drawn extensively on the columns of this journal for propagating his numerous original contributions. He regarded the Annals as a primary sounding board to test check the validity of various hypotheses and theories advanced by him from time to time.

They say example is better than precept. Dr. Ranganathan's illustrious example of dedicated and selfless service which has left an indelible impress on the sands of time will continue to be a source of sustained inspiration for generations of librarians, documentalists and information scientists which follow. INSDOC and Annals of Library Science and Documentation can pay no greater homage to the memory of their great mentor than to renew their pledge to live upto the ideals and expectations cherished by him.

J.K. Ahluwalia
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INTRODUCTION

I am a new entrant to the profession of library, information and documentation sciences. My entry to this proffession came in May 1989 when I took over as the Director of INSDOC. My introduction to Dr Ranganathan is even more recent. It is only a few months ago that I have started reading and learning seriously about Dr. Ranganathan's work, thoughts and contributions. The first thing; I learnt about him was very reassuring. Dr. Ranganathan was a mathematician who was thrust into library profession. In a way, I, who am basically a computer communication engineer, also came into this profession by a strange happening. I would not venture to write here the details of how it happened lest you might consider me very unscientific. But it can be well imagined that there must have been an unusual motivating factor for a professor of computer and communication engineering at the Indian Institute of Science, Bangalore to move to an organisation which was known to have been ailing for sometime to take up a position which offered no material benefits and was in a city which one would rarely choose when compared to Bangalore. In fact, some peer scientists of the country were at a loss to know why I am making this move and went even to the extent of saying that I was making a grave mistake and would feel miserable in my new assignment in two years time. I have already spent three happy years in this profession.

Dr. Ranganathan was a profound thinker and prolific writer. There is not a single aspect of library science and profession that he has not touched. To get a feel for numbers, one of the records states that Dr. Ranganathan has published more than 2,000 articles, authored or edited over 50 works and written scores of reports and several hundred technical notes. It is childish to think that one can read and understand the contributions of this great personality in a few months time. One can spend a whole life time studying Ranganathan's works and yet feel that there is so much more to be explored.

FIVE LAWS OF LIBRARY SCIENCE

Dr. Ranganathan has expounded five fundamental laws of library science which have become famous now:

1) Books are for use
2) Every reader his book
3) Every book its reader
4) Save the time of the reader
5) Library is a growing organism

When I first read these laws about two years ago, I thought what kind of a man Dr. Ranganathan had been that he did not even write proper English. What does "Every reader his book" or "Every book its reader" mean? Needless to say, I neither understood nor appreciated these laws at that time. It was only when I read Ranganathan's own exposition of these laws, I realised the profoundity of the laws.

Almost all of Dr. Ranganathan's writings that I have read so far have impressed me and continue to influence my thoughts. But one passage struck me like lightening. I quote
"A book is like a dry cell containing thought-energy transformed into a portable material".

The duty of a library is
"to help the retransformation of books into thought. This thought may be merely absorbed by many for their own immediate benefit. It may also lead to the creation of new thought by some, for the use of humanity at large".

I found many thoughts in Dr. Ranganathan's books that are of immediate use to me. I have already initiated action to implement some of these ideas in the National Science Library at INSDOC. There have also been thoughts in his writings that have set me thinking further. One among these is his exposition on the fifth law, viz., *"Library is a growing organism".*

LIBRARY IS A GROWING ORGANISM

Dr. Ranganathan recognises two kinds of organic growth: Growth as of the body of a child and growth as of the body of an adult. The body of a child grows steadily in size and weight. Whereas, the growth of an adult body consists only of a continuous replacement of cells and tissues. Having recognised these two kinds of growth, Ranganathan compares the growth of a storage or repository library and a service library to that of child and adult respectively.

A Newly started service library grows steadily in the number of its readers, books and staff. After sometime, there can be no appreciable increase in the number of readers or books or staff of a service library. There after, its growth consists of only new generation of readers replacing the old, a new set of books replacing the old and new staff replacing the old.

On the other hand, a repository library continues to have child-growth for ever in respect of books and staff. That is, there can be no limit to the size of its book collection or its staff. It may attain the stage of adult-growth only in respect of its readers.

Dr. Ranganathan then goes on to describe various aspects of library requirements. For example, the building of a repository library should be capable of indefinite growth. The site chosen for it should be very large indeed. Its building, particularly the stack room, will have to be extended in a number of successive phases. On the other hand, the building of a service library need not grow beyond a certain size. The site chosen for it can be relatively small. Perhaps, the building can be erected to its maximum size in not more than two or three phases.

Now, what I am interested in is to see how this organism is likely to grow in the future with the advancements that are taking place in the field of information technology. I visualise information technology as a composition of electronics, computer, telecommunications, artificial intelligence and human-machine interface technologies. All of these will have profound impact on the way libraries grow in the future.

Let us first look at the electronic library which is likely to become a reality in about 50 years time. We see glimpses of the coming electronic libraries in CD-ROMs. Increasingly, information is being published on CD-ROMs instead of printed forms. Even existing printed books are being copied on to CD-ROMs for compact storage and easy transportability. One may visualise the future library with stacks full of CD-ROMs and reading tables having a computer with a CD-ROM drive. A user may pick a CD-ROM from the shelf and place it in his computer and read. Would this model work? Today a single CD-ROM disk can hold about 50 books. If a reader takes away a CD-ROM from the shelf, he is carrying away 50 books with him. Other readers are now denied access to 49 books which are not currently in use, a problem that we do not encounter in today's libraries.

Is there a solution for this problem? Does a multi-user CD-ROM drive provide a solution? In a multi-user drive, many users can obtain access to the same CD-ROM. But how many users can a multi-user drive system support? Today, a sophisticated multi-user system that can assure reasonable response time supports a maximum of sixteen users. Theoretically, to match today's library flexibility, a multi-user system must at least support as many users as there are books in CD-ROM disk. This is very unlikely to happen in practice. Simultaneous with the increase in the number of users supported by a multi-user system, the density of storage in CD-ROMs is also likely to increase, with the result, the number of users on the system will ever be less than the number of books on the CD-ROM. Thus, the technology seems to have limitation in meeting even the rudimentary facility that a library offers today.

On the other hand, this technology makes possible something that is not possible but desirable in today's libraries. A single copy of a publication can be read by a number of users simultaneously. Now, consider a library which has a provision for 200 readers. How many CD-ROM drives does this library need? Assume a multi-user drive capable of supporting 20 users. Will 10 drives suffice? We are getting into an interesting problem here. Let us suppose that the library has 1,000 CD-ROMs in its collection. With 10 drives only 10 CD-ROMs can be supported on-line. What happens if the reader population is such that what they want to read is on 200 different CD-ROMs. A requirement like this is easily met in today's library. If you want to meet this in an electronic library, we need 200 drives each one capable of multi-user support which is an expensive proposition.

Instead, one may consider CD-ROM jukeboxes. In a jukebox, many CD-ROMs are placed and any one can be chosen at a time for reading. Today's jukeboxes have 12-24 CD-ROM slots. The time for changing from one CD-ROM to another is large in these systems. As a result, if the reader population is such that each one is wanting to read a different CD-ROM on the jukebox, there would be so much of CD-ROM swappings taking place, that a user would find the response time totally unacceptable. This situation becomes worse if the users are browsing the publications rather than seriously reading through them. In any case, to satisfy 200 users as today's library would do, we need to satisfy the condition:

No. of users per system X No. of CD-ROM slots per system = No. of readers

This is only a necessary condition but not a sufficient condition. Consider the situation, when a user walks into the library and finds that a CD-ROM he wants is already loaded on a system which is fully occupied. But there are other systems which are vacant. He has no way of accessing the publication he wants even though there is enough spare machine capacity. This problem can be solved by making the multiuser jukeboxes networkable. In this case, all the users of the library can get access to any of the CD-ROMs in any of the jukebox systems. Response time problems will crop up in large libraries having such configurations.

There are other interesting problems that arise with regard to this model of electronic library. How do you cluster items on a CD-ROM?

Do you place items belonging to the same subject on one CD-ROM?

How do you assign a call number to a CD-ROM. If a user wants to look at a number of related items, how does he fetch the relevant CD-ROMs?

A CD-ROM contains 50 or more publications. it is manufactured in a factory. Does the manufacturer put the publications in the chronological order in which he receives them without regard to subject, etc.? He may not release a CD-ROM unless adequate material has become available for filling up the CD-ROM. What happens if there is a big time gap, say one year or so, between the first piece of publication and the last piece of publication that go on the CD-ROM? A library may not be interested in all the publications put on CD-ROM. It may be forced to acquire a large number of CD-ROMs although all its required collections may be placed in a few CD-ROMs. What role the librarian would play? How would he/she help in the process of transforming the contents of CD-ROMs into thoughts? There is a host of other issues that one can think of.

However, Ranganathan's concept of growing organism still applies to electronic libraries. An electronic service library which serves a limited geographical area still follows the concept put forth by Dr. Ranganathan in toto. However, in the case of repository library, the staff may not grow as envisaged by Dr. Ranganathan. Staff requirement may now be more governed by the number of user stations rather than the number of CD-ROMs.

Let us now turn to teleelectronic library or simply telelibrary. A telelibrary permits a user to read a publication from his home or any other suitable telecommunication service point without having to physically go to the library. If this concept becomes a practical scheme, libraries will be organised much the same way as telephone exchanges are organised today. Each library will have a communication subsystem that links it up to other libraries. This would mean that the entire world population becomes users of any library. For example, anyone sitting in the United States can access and read a manuscript collection in the Saraswathi Mahal library of Thanjavur. A semblence of such a development is seen in today's networks. It is possible for one in India to access OCLC or the Australian Bibliographic Network and obtain information about the holdings. Today's networks are primitive. We have a long way to go before they can evolve into fullfledged networks where one library's collection can be perused from another library or from one's home. More and more I think about all this, it appears to me that library is indeed a growing organism, but the growth at this point of time does not concern itself with the physical aspects but more of the meta physical aspects. And in this plane, there is no limit to growth. An adult or a child makes no difference.

PROF KAULA GOLD MEDAL AND CITATION

Prof. Kaula Endowment for Library and Information Science has decided to award Gold Medal and Citation to a person who distinguishes himself as a librarian, documentalist or a teacher of library and information science. The award will be made every year by International Awards Committee.

Prof. Emilia Carras, Academician of the Royal Doctor's Academy to Madrid and the Director. of the Departmeent of Scientific Documentation, Universidad Autonoma, Madrid has been selected for the award for the year 1990 in recognition of her outstanding services for the cause of library and information science.

RANGANATHAN - KAULA AWARD

The Endowment has decided to Institute an Award for Indian Librarians and Information Scientists. The award will be offered to an Indian professional who has made distinct contributions in the field. The award will be made once in two years from 1980 onwards. Dr. P.A. Mohan Rajan gets the award for the year 1990.

The Endowment invites nominations for Ranganathan Kaula Award for 1992 and Prof. Kaula Gold Medal Award for 1991.

DAMODAR SCHOLARSHIP

The Endowment has also instituted the scholarship to help a needy and competent person to continue the studies in library and information science. An yearly scholarship will be offered by the Endowment based on the applications received and selected through a committee set up for the purpose. Persons who need this scholarship may send the application with all details at an early date to the following.

Shri V. Venkatappaiah
Secretary
Sriharsha Bhavan,
Srinagar 6th line,
Guntur 522002
India

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THE RELEVANCE OF Dr. RANGANATHAN'S IDEAS IN THE INFORMATION AGE

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Briefly examines the relevance of Dr. Ranganathan's ideas and contributions in the present context of information age. Citing the implications of his five laws of library & information science interprets their value in the present day information handling problems. Lists a few areas for the application of his methodology of subject structuring. Mentions the groundwork for library routines as analogous to algorithms for computer programming and analysis for PERT/ CPM. Suggests that his ideas are valid even today for serious study.

INTRODUCTION

Dr. Ranganathan's contributions to the library and information field are sagacious and profound, considering their relevance even in this age of information. More particularly, his endeavors to put India on the world map of library and information science have been unique, immense and unmatched.

In this brief, rather cursory account, an attempt is made to focus attention on a few of his ideas to perceive their import in the changing context of information. These ideas relate to

- Five laws of library and information science;
- Methodology for the design and development of the intellectual organisation of knowledge; and
- Job, work and load Analysis of library operations.

FIVE LAWS

The five laws of library science considered in the present emphasis on Information, can be restated to accentuate on information. The earlier reference to 'books' and 'libraries' are replaced by 'information' and 'information systems' as the former were valuable only because books carried information and knowledge and were stocked in libraries. Restated five laws read as follows:

- Information is for use;
- Every user his/her information;
- Every information its user;
- Save the time of the user; and its corollary save the time of the library and information staff; and
- Information system is a growing organism

The First Law:

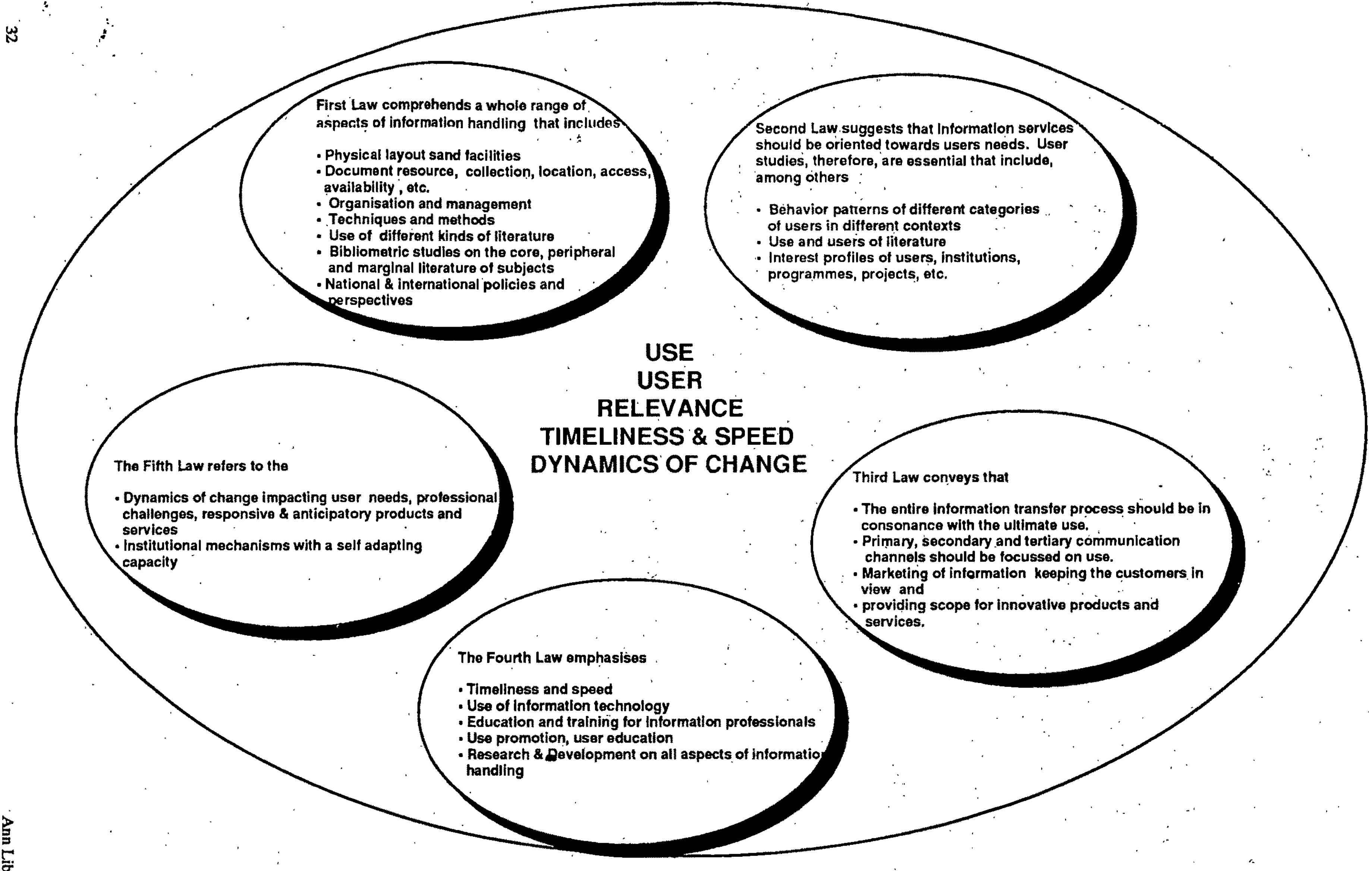
It stresses the value of information as a vital component in every human activity. In the information society, as conceived today, information is viewed as a resource, a commodity and a basic input to all growth and developmental activities, quite in conformity with the way Ranganathan propounded it. In fact, the old adage 'Knowledge is Wealth', 'Knowledge is Power', is being captured in these ideas to reinforce the power of knowledge that transforms a non-resource into a resource.

In essence the first law comprehends a whole range of aspects of information handling which includes

- Physical layout and facilities;
- Document resource, collection, location, access, availability, etc.;
- Organisation and management;
- Techniques and methods;
- Use of different kinds of literature;
- Bibliometric studies on the core, peripheral and marginal literature of subjects;
- National and international policies and perspectives;
- and similar others

The Second Law:

It suggests that information services should be oriented towards user needs. User studies, therefore, are essential comprising the following:



First Law comprehends a whole range of aspects of information handling that includes

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- Organisation and management
- Techniques and methods
- Use of different kinds of literature
- Bibliometric studies on the core, peripheral and marginal literature of subjects
- National & international policies and perspectives

Second Law suggests that Information services should be oriented towards users needs. User studies, therefore, are essential that include, among others

- Behavior patterns of different categories of users in different contexts
- Use and users of literature
- Interest profiles of users, institutions, programmes, projects, etc.

The Fifth Law refers to the

- Dynamics of change impacting user needs, professional challenges, responsive & anticipatory products and services
- Institutional mechanisms with a self adapting capacity

Third Law conveys that

- The entire information transfer process should be in consonance with the ultimate use.
- Primary, secondary and tertiary communication channels should be focussed on use.
- Marketing of information keeping the customers in view and
- providing scope for innovative products and services.

The Fourth Law emphasises

- Timeliness and speed
- Use of information technology
- Education and training for information professionals
- Use promotion, user education
- Research & Development on all aspects of informatio handling

Schematic representation of the Five Laws

- Behavior patterns of different categories of users in different contexts,
- Use and users of literature,
- Interest profiles of users, institutions, programmes, projects, etc.

The Third Law:

It conveys that the entire information transfer process should be in consonance with its ultimate use. The familiar principle 'Right information to the right user at the right time' is communicated here. Primary, secondary and tertiary communication channels should be focussed on use. In other words marketing of information keeping the customers in view is stressed, providing scope for innovative products and services.

The Fourth Law:

It emphasises the value of 'Time'. Timeliness and speed are the very essence of service. Use of information technology enables a total metamorphosis in improving means and mechanisms to provide high quality service. Information professionals should be geared to this transformation process that hinges on education and training. Use promotion, education for use skills and user friendliness makes the use of a system not only simple but saves a great amount of time. Continuous research on all aspects of information handling is an absolute necessity keeping all these factors in mind.

The Fifth Law:

It refers to the dynamics of change which is seen in the evergrowing, sometimes turbulent advancement of knowledge, which is never ending. The institutional mechanisms with a self adapting capacity to changing environments are to be constantly evolved; the need for it is to be appreciated and understood as a necessity. All these have implications on the formulation of national and international information policies and perspectives.

In substance, it can be safely inferred from these laws that Dr. Ranganathan wished that libraries and information institutions should function as partners with specialists in all intellectual pursuits, economic and social development activities, all round higher productivity, in short in every activity that raises the quality of life.

The five laws have been represented in a schematic diagram given in Fig. 1.

INTELLECTUAL ORGANISATION OF KNOWLEDGE

The methodology propounded by Dr. Ranganathan for structuring a subject, primarily for the design and development of depth classification schedules, provides a useful framework for a number of similar types of concept organisation and retrieval. The postulates and principles enunciated in this methodology can be profitably applied to studies such as

- Creation of Expert Systems for knowledge organisation,
- Setting weighted Boolean for computerised information storage and retrieval,
- Design of Information Retrieval Thesaurus,
- Presentation of ideas in technical writing and
- Organising thoughts in any specific area for oral presentation

JOB AND WORK ANALYSIS

The operation of functions in a library or for that matter in any information institution require a thorough and complete analysis of every minute job and operational routine needed to be set up to carry them out in a systematic way. Dr. Ranganathan gave a basic groundwork for setting routines in libraries and information centres which may be deemed analogous to setting algorithms for computer programming or analysis needed in network analysis.

SOME OBSERVATIONS

Although the above cursory listing of some of the areas wherein Dr. Ranganathan's thinking can be useful, may appear to be a little over reading into his ideas, the fact remains that his contributions give scope for deeper studies and analysis in the present context of design and development of computerised information systems. It may not, therefore, be imprudent here to suggest that Dr. Ranganathan's ideas deserve careful study by those who are lured to the application of modern information technology to information handling.

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LASTING IMPACT OF RANGANATHAN

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Dr. S. R. Ranganathan was a mathematician by training and temperament, an inquiring scientist with intellect, a philosopher deeply rooted in the lore of Indian thought and culture, and an academician of rare brilliance in approach and outlook. Much before Michel Foucoult, Dainel Bell, J.F. Lyotard, Alvin Toffler, etc; both Melvil Dewey and H.E. Bliss, and S. R. Ranganathan had realised that knowledge was the real power and it had to be widely disseminated by libraries. People generally take Ranganathan only as a librarian, which he certainly was. He worked for librarianship for about fifty years until he died.

But in the making of Ranganathan one cannot ignore that he was born in a village in India, he was a South Indian Brahmin, he was a student of mathematics and indology, and that he was a qualified teacher and had taught as a college lecturer before he became a librarian. Finally, one must not ignore that a village lad, with a rudiment of education and experience had to study the British libraries and the European society, where libraries exercised a modernizing influence which was not the case in his motherland.

The power of a modern library and its active use by the society concerned can always explain the relative strength of a society as compared to the society where libraries do not exist.

Ranganathan. strongly believed that knowledge represented real power. This lent added strength to the role of libraries as instruments for dissemination of knowledge. In the personality of Ranganathan, quest for learning was the most dominant factor. As a librarian he was able to study extensively making full use of the opportunity available to him. Equally dominant was the factor of his sound mathematical background which characterized his style, efforts, thinking, models and solutions.

PATTERN MAKER

There is no gainsaying that Ranganathan belonged to the category of pattern makers. A pattern maker is, generally , a person possessed of a rare combination of talents. He reaches a high standard in several different directions and combines intellectual gifts not often found together. He takes the knowledge available in his day, re-discovers it, reinterprets it and synthesises it. He refuses to live in the past, although he must gladly seek light from the past to illuminate and clarify the path towards future. No matter howsoever iconoclastic, a pattern maker must be able to take the past with him in his theories and thoughts. His debt to the past is immense indeed. The versatility of a Pattern Maker is a continual surprise. Ranganathan followed this path in various inventions that he contributed.

A pattern maker harvests the gains of cumulative efforts and organises a crude heap of facts systematically. Some concepts of pattern makers go through a long period of travail and agony before they are accepted. Like a fresh strong wind a pattern maker sweeps through the world exhibiting a shocking insensibility to the cherised notions of his fellow men. The library world from 1930 to 1970 experienced this phase. So strong was the storm generated by him that the then existing myths were torn down. The hypothesis of Ranganathan was much more than a guess or fiction. As a preliminary supposition, lacking full proof, nevertheless, it led to improved understanding. Ranganathan rejoiced at the complexity, its incomprehensible bulk and endless details and tabled it with his peculiar penetration, comprehensive analysis, systematic formulations and open-ended devices. So was his colon classification and cataloguing code. The foundations of a new structure were laid by Ranganathan and he often polished the minarets of his newly created structure, through different editions of his various works.

Ranganathan gave suprisingly good answers to age-old questions. His one experiment overthrew the folly of centuries of beliefs. Ranganathan's concept of categories exactly did that. Always a number of minds were very near to a truth before the mind of Ranganathan fully comprehended it. Hence, theories of Ranganathan were the culminating point reached through several lines of advances by widely separated and unconnected thinkers like Melvil Dewey, H.E. Bliss, and others. Yet, Ranganathan achieved the final apothesis, in categories, phases, planes of work, etc.

WELDING IDEAS AND PRACTICE

Man is sometimes compared to a bird. He is said to start from nowhere and arrive at nowhere. However, his flight is appreciated as superb. But, Ranganathan did arrive somewhere even if he had started from nowhere. His flight was also superb. Ranganathan first shocked then convinced and ultimately revolutionised through his majestic thought that please do analyse and then synthesis, what ever you do in information science. He possessed architectonic qualities. A connection existed in his contributions wherein one part supported the other. He developed a tower as against a balloon.

'Theorists' has been a slang of approbrium generally hurled at him. But his theory was an honest theory, containing all essentials of a true view. He gave us some rare entities not easily available to experience. It is through Ranganathan that we understood as to why entities behave as they actually do. He was gifted with a new vision through which he projected and shed fresh light and interpretation, e.g. books are for use. His intuition was for unknown entities-isolates, facets, relations, etc. He was a searcher after truth and battled almost alone on the vast frontiers of knowledge and its formation. He gave to his theories the 'open-endedness'.

He enjoined upon himself the task of weaving and welding the tentative ideas and practices, prevalent upto his age, into coherent and convincing forms of lasting value in library and information science. By leaving his forms open-ended (hospitality, etc.) he made the provision for further development by anyone taking pains to work upon them. Ranganathan did give classification and cataloguing, and other subdisciplines, coherent and convincing forms and these forms are certainly open at their ends, which may be manipulated by his successors as much as they wish. By all consideration, the recognition of his ideas and acceptance of his theories all over the world during his own life time is a remarkable phenomenon because in the history of ideas many have failed to win universal recognition during their life time.

NEWTONIAN APPROACH

By this time it is obvious to us, in human experience, that in the case of ideas, thoughts, principles and postulates, a ceaseless process of refinement and improvement takes place from time to time in each generation. We should be able to mark clearly, pin-point, accurately and say quite boldly that here was where certain ideas were first clearly expressed and that here modernity really began in the discipline concerned. Ranganathan without doubt deserves this credit. On looking into the story of Ranagnathan, one finds that a single scholar made multidimensional contributions to various aspects of the discipline now known as library and information science. Ranganathan was the first to introduce the fundamentals of scientific thought in Library and Information Science by applying the Newtonian approach of *What? Why?* and *How?* Like Darwin's voyage in 'The Beagle', Ranganathan went from pillar to post in British libraries looking searchingly into the merits and demerits of their working.

He adopted the Aristotlian approach of succinct analytical thinking in the idea plane and, like Aristotle, Ranganathan's task was to study characteristics and categories. If Aristotle held that language reflected the real world, to Ranganathan library and information science with emphasis on the idea plane reflected the real world. Just as Aristotle said that meaning of words is different when they stand alone than the meaning of words put together into sentences, Ranganathan also observed that connotation and denotation of isolates are different when they stand alone, from their lamination or combination into a specific subject. As to Aristotle the judgement of a preposition meant the meaningful linking of several separate concepts and their meanings, so to Ranganathan classification of knowledge was the linking of separate facets of a subject, and the multiple isolates in facets, into relevant and meaningful concatenations. In the field of library and information science, Ranganathan's adoption of aphoristic (Sutra) style came nearer to the principle of 'Atomic Unit Thought'.

The mass of Ranganathan's books, published papers, manuscripts and correspondence reveals a person Newtonian in qualities of mind, physique and personality, extraordinarily favourable to the making of a great scientist. His life, both mental and physical, was propelled by tremendous power of concentration, ability to stand long periods of intense mental exertion and objectivity uncomplicated by frivolous interests. Ranganathan's searching eyes, penetrating vision and an alert assimilative mind always and ceaselessly applied their dynamic roles to problems and propositions to theory and thought, without getting tired or bored.

BELIEF IN GOD

Like Einstein and other great pattern makers, Ranganathan was a firm believer in God. The frequent recurrence of invocations to God and other deities in Ranganathan's works and conversations show his religious convictions. If a good plan did not go through, that too, for Ranganathan was due to the wishes of God. Very much like Einstein, Ranganathan's God manifested Himself in the harmony of the universe, hence, also for him there was no conflict between religion and his scientific work [1].

Any one who has had the privilege of sitting at the feet of this God-gifted great master, of knowing him intimately and of watching him work with dexterity from dawn to dusk would wish to honour Ranganathan with the Shakespearean acclaim of an ideal man:

What a piece of work is man!
How noble in reason!
How infinite in faculties!
In form and moving, how express and admirable!
In action, how like an angel!
In apprehension, how like a God! [2]

Ranganathan's genius was of a very high order covering many powers, and it could best be described in the words of Edwin Percy Whipple from his book 'Literature and Life' (1849):

"Genius is not a single power, but a combination of great powers. It reasons, but it is not reasoning; it judges, but it is not judgement; it imagines, but it is not imagination; it feels deeply and fiercely, but it is not passion. It is neither because it is all."

It is certain that Ranganathan knew about the limitations of his contributions in relation to the future. Through his work he appears to have melted centuries into one, yet he knew that there was no finality about his works in classification, cataloguing and other areas of library and information science. But the 'open ends' in his system - principles and canons, postulates and theories, methods of analysis and synthesis - were going (he knew) to contribute the genetical force needed to foster library and information science in the future.

PATTERN RECOGNITION

Pattern making or the development of patterns as the objective correlative of human thinking is as memorable as the mental and psychological activities of the man. But pattern recognition with the help of quantifiable coefficients, particularly, in the field of information science is a development of very recent origin. The International Conference on Methodologies of Pattern Recognition held at Honolulu in 1968 emphasised the fact that the entire attention of information scientists, hitherto, had been devoted to the development of patterns in information codification and computer science. Unless the process of pattern development is supported with the process of pattern recognition in terms of examination, evaluation and development of theories, all work done so far may result in unproductive accumulation. Outlining the purpose of the conference, Satosi Watanabe, the pioneer of the concept of pattern recognition, said:

"To the layman's ear, the term pattern recognition sounds like a very narrow esoteric field of electronic computer applications. But actually it is a vast and explicit endeavour at mechanization of the most fundamental human function of perception and concept formulation. It represents indeed one of the most ambitious scientific ventures of this century requiring collaboration of electronic engineers, physicists, physiologists, psychologists logicians, mathematicians and philosophers.

In the recent years, pattern recognition has definitely emerged from the status of programming stunt to become a respectable branch of scientific art. This implies that from now on, the progress in the field will no longer be as dazzling as in the past, but that it has to become more solid and systematic. We can no longer congratulate ourselves because "it works" but we should ask why it works, and explore the limits beyond which it will not work. Today, therefore, is a good time for researchers in this field to sit back a while to evaluate the significance of their past achievements and to dream, prospect, and plan their future paths. This will require, above all, a soul-searching methodological examination of the entire enterprise of pattern recognition" [4].

It is in this context that there is an immediate need to examine Ranganathan's work from a new angle. Fifty precious years of his life time went to the process of patern recognition and development in various areas of knowledge and library and information science, and now there is a need to prospect and plan for the future of information processing in relation to the glorious past built by this great master.

MODES OF FORMATION OF KNOWLEDGE

Epistemology, by the middle of the twentieth century, could not retain its pure philosophical character. It could not remain a subject for armchair thinking any more. In addition to the theory and the nature of knowledge an emphasis had to be focussed on the modes of the formation of knowledge in various subjects. Unless, the generalised ways of the formation of knowledge were critically examined and scientifically established, much of the understanding of the theory and the nature of knowledge would remain incomplete. Somebody had to examine scientifically the physiology of the emergence of newer units of knowledge. This study was done by Ranganathan. Continuous growth in the body of knowledge has been constantly bothering epistemologists. In order to organise and evaluate the data of knowledge, epistemologists have to study the scientific way comprising the nature of the formation of subjects [5]. Terms like ideal of unity, rational and irrational, pedagogical reasons, logical derivation, etc. could not be of greater meaning in absence of a full grip over the modes of formation of newer units of knowledge through specific subject. A mathematician-librarian in Ranganathan was involved in classifying the whole knowledge and it was for the first time that he asked the question, how subjects are formed? Ranganathan demonstrated these patterns of formation of knowledge through numerous examples and was able to convince classificationists about the nature of formation of the subjects as units of knowledge.

POLYCHOTOMY AND BANYAN TREE

In addition, Ranganathan did explain the ways of division and therein he covered the dichotomy (attempted by Kent) and the tree of porphyry (fancied by Bentham). Then, Ranganathan examined the method of decachotomy (with ten divisions) and found that in view of multidimensional prolific growth, neither it was beautiful nor sufficient. So he naturally suggested that the pattern of mapping knowledge should be polychotomy (numerous unlimited divisions). In place of the tree of poryphyry, he brought in the "Banyan Tree". To give his relevant findings an acceptable form he measured the growth in the spiral of the development of new subjects and identified certain stages [6].

Ranganathan's contributions on the ways of the formation of the units of knowledge, shall continue to guide epistemologists and information scientists in their understanding of the theory and the nature of knowledge in addition to being a source of the classificatory activity of knowledge.

POINTER FOR COMPUTER SCIENTISTS

Ranganathan succeeded in individualising one particular specific subject from millions of specific subjects. He was able to individualise one book from the nth number of books. He did so through certain postulates and cannons. Can our software specialists benefit by studying Ranganathan's "Prolegomena to Library Classification" in their attempt to individualise one particular file from millions of files? Lanes and byelanes of Ranganathan's tracks are similar to the tracts of software computer scientists because both deal with idea, verbal and notational planes. Then, why ignore the work of a librarian measuring units of knowledge/data in files or in books? Can the computer scientists examine the ways of processing knowledge and its units for individualisation, where Ranganathan made some unique scientific contributions? Computer scientists may ultimately reject Ranganathan but, I think, Ranganathan deserves a study by them, through a unified global approach.

(Based on the work; Srivastava A P: Ranganathan a pattern maker, New Delhi, Metropolitan, 1977).

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WITH Dr. S.R. RANGANATHAN ON STANDARDS FOR DOCUMENTATION

Gurcharan singh
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Writing about Dr. S. R. Ranganathan, Dr. Lal C. Verman, who is variously regarded as the Great Moghul of the standardization movement in India, had once remarked, "Every Indian who has any interest in libraries, library science, documentation or any allied field has a justifiable pride in being the fellow countryman of Dr. Ranganathan whose talents and genius have contributed so much to the advancement of knowledge in the world". Dr. Ranganathan's notable contribution to upgrade the status of library and documentation technologies to the level where they have become accepted as distinct disciplines of studies in their own right has been under limelight all along. But what might not be equally in the common knowledge is the pioneering lead he gave to the activity of developing and applying standards in the realm of documentation, information retrieval and library fittings and furniture to realize various economies including economy of intellectual effort.

It was a matter of good chance that Dr. Ranganathan came in contact with the Indian Standards Institution (ISI - the predecessor body of the Bureau of Indian Standards) right at the time of its creation in 1947. Dr. Ranganathan was at that time busy in establishing a School of Library Science in the University of Delhi. The Indian Standards Institution was under the stewardship of Dr. Lal C. Verman who had also a colossal task at his hands to establish the national standardization movement on a firm footing. It will stand to the credit of these two titans of modern India that they could foresee and appreciate the important role which standardization could play in the realm of documentation and the strength it could lend to various programmes of economic reconstruction which came to be unleashed subsequently.

INFRASTRUCTURE FOR STANDARDS

For delivering its mandate in a systematic way, the then ISI constituted apex bodies called Division Councils for guiding development and promotion of standards in specific sectors of industry and trade. To begin with, there were only three Division Councils dealing with Engineering, Chemicals and Textiles. Subsequently, as the work expanded additional Division Councils were created to man activities in the areas of Food and Agriculture, Electrical Engineering, Electronics, Metallurgy, Civil Engineering, etc.

For actual development of standards, these Division Councils constituted specialist sectional committees. Each sectional committee carried responsibility to formulate and promote standards in its assigned sector. For example, under the Chemical Division Council, there are different sectional committees for development of standards for acids and alkalies, industrial gases, paper and its products, paints, soaps, explosives, etc. The Division Councils monitored and controlled the activities of sectional committees in the sense that they approved the themes for standardization and ultimately accorded approval to the standards as formulated.

DOCUMENTATION SECTIONAL COMMITTEE

The Documentation Sectional Committee of the Bureau came to be established on 15 October 1947 under the Chairmanship of Dr. S. R. Ranganathan. Chronologically, it was the third Sectional Committee to be set up. As at the time, there was no Division Council specializing in this field, the activities of the Documentation Committee were placed under the overall supervisory control of the Executive Committee (EC) which was the apex advisory body of the Bureau exercising control on its day-to day administration.

Both Dr. Ranganathan and Dr. Verman were conscious that the Independence was bound to stimulate far-reaching developments in the field of education, science, technology and industrial production and distribution systems. The pace of generation of new information in academic institutions, research laboratories and R & D establishments was bound to multiply manifold.

Information feeds on itself. As such, to lend the needed strength to programmes of research and development, it was essential that the new information was properly documented, coded in an easily retrievable manner and made available on demand expeditiously.

On the other front, there were programmes of vast expansion in a number of libraries including those in schools, colleges and technical institutions. The existing libraries were also bound to grow and expand phenomenally to facilitate easier access to information. All these factors indicated strongly the need for standardization to get the maximum mileage out of the available funds for library buildings and library furniture and fittings.

EVOLUTE OF STANDARIZATION

The first task before Dr. Ranganathan was to analyse the documentation activity and examine its individual spectral zones for determining their amenability to standardization. He presented the result of his analysis in the form of the now famous diagram 'Evolute of Documentation' (see Fig 1).

The activity of documentation had its origin in the stimulation of thought process. The end results of the thought process were embodied into publications like thesis, research papers, technical reports, technical books, monographs, etc. These publications eventually found their way into libraries and information centres where they were classified, catalogued, indexed and placed on display shelves. Side by side, activities went on for their abstracting, reviewing, etc. for bringing them to the active notice of their interested users. The process of documentation was thus involved with the creation of original writings, publications of these writings in the form of documents by printers and publishers, acquisition and proper housing of these documents in libraries and finally dissemination of information in their regard.

Dr. Ranganathan's analysis brought out that there were certain areas like creation of writings, visualization of graphics, cover designs, documentation service, etc, which were not amenable to standardization. But then there were other areas like stylizing of texts, certain minimum elements of information to be given on preliminary pages of a book, symbols for proof corrections, glossaries of terms, library procedures, preparation of abstracts, layout of catalogues, library buildings and furniture, etc., where recourse to standardization could bring in sizeable economies including economy of intellectual effort.

It was fortunate that the Documentation Sectional Committee as constituted at the time had on its rolls a number of stalwarts which subsequently acquired the mantle of the leading lights of the profession in their own right. The list included names like Shri B. S. Kesavan (National Library), Shri S. Das Gupta (Delhi University), Shri R. C. Gupta (National Archives), Shri U. S. Mohan Rao (Information and Broadcasting-Publication Division), Shri P. N. Kaula (Banaras Hindu University), Shri S. Parthsarathy (INSDOC), Shri Jainath Kaul (ISI), etc. All these luminaries commanded unique vision and the combined efforts of all of them gave a brillant start to the standardization activity in the documentation field which won acclaim even at the international level.

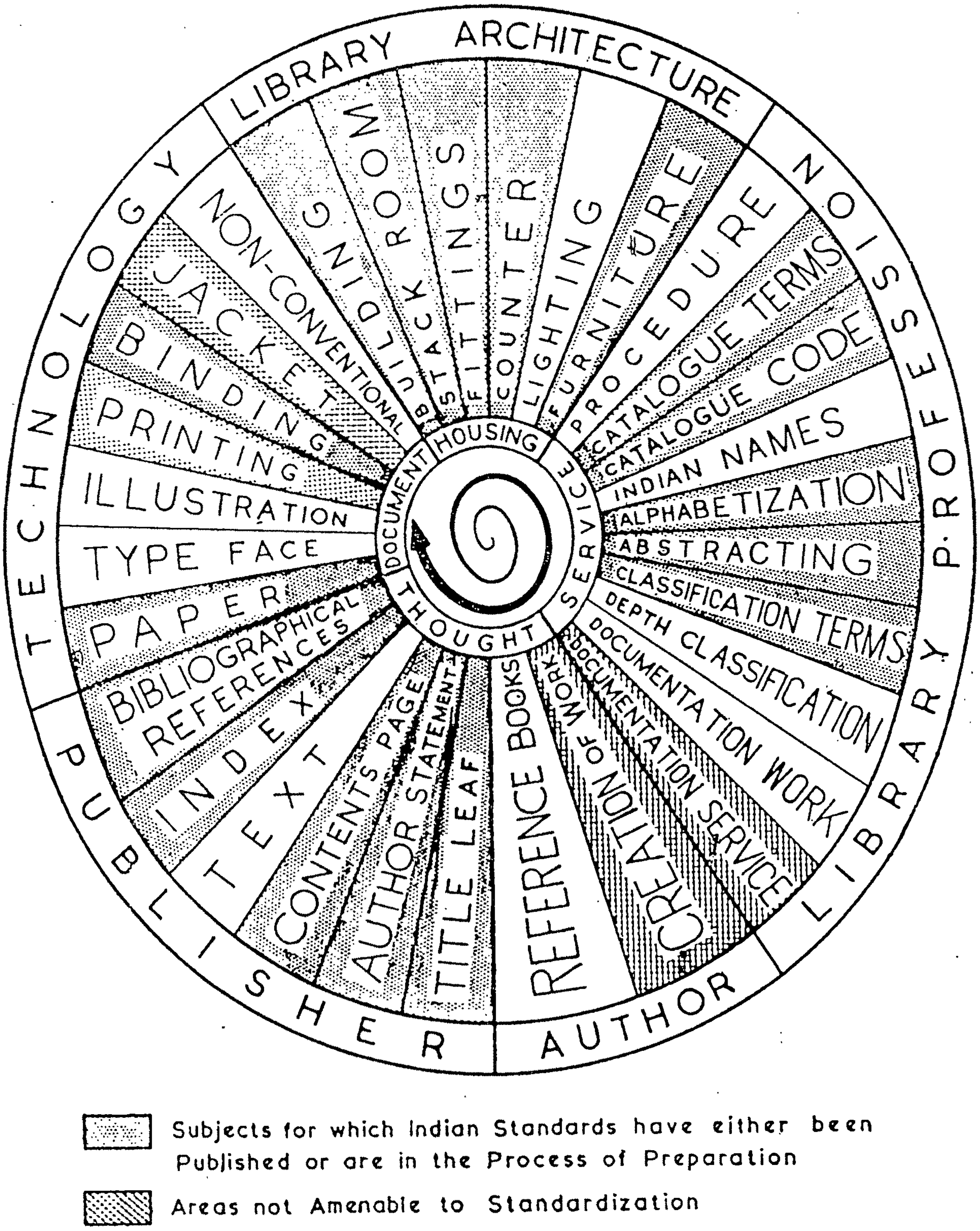
DOCUMENTATION STANDARDS

It would bear mentioning that the very fourth standard brought out by ISI pertained to the Documentation Committee, i.e. IS:4-1949: Practice for make up of periodicals. The first standard i.e. IS:1 naturally dealt with the National Flag of the country. IS:2 and IS:3 dealt with two basic themes, namely, rules for rounding of values and conversion of inch dimensions into millimeteres. These standards were developed by the ISI Directorate's own technical committee which functioned under the Chairmanship of Dr. Verman.

Close on the heels of IS:4 came standards like abbreviations for titles of periodicals (IS:18), practice for alphabetical arrangements (IS:382), preliminary pages of a book (IS:790-IS:794), canons for making abstracts (IS:795), glossary of cataloguing terms (IS: 796), proof correction symbols (IS:1250), indexing practice (IS: 1275) library catalogue codes (IS:1358), and bibliographical references (Is:2381).

Among these, particular mention may be made of standards for the author statement on the back of the title page of a book (IS:793) and the standard for proof corrections (IS:1250). The increase in the volume of publication activity was bound to complicate the problem of identification of authors having common names. To overcome the problem, Dr. Ranganathan suggested that the names of the author(s) followed by the year of his (their) birth in brackets (or full span i.e. year of birth and year of demise where the author is already deceased) may be given on the back of the title page of a book. This device called author statement has become accepted universally and is playing a useful role in individualizing the identity of authors having common names.

Because of the historical reasons, the printing industry in India was using proof correction



EVOLUTE OF DOCUMENTATION

symbols promulgated by the British Standards Institution (UK). These symbols also included certain lingual expressions like 'see copy', 'trs' (for transpose), etc., Dr. Ranganathan, therefore, gave a lead in developing a set of symbols based on graphics only which can be used for marking proof corrections in texts in any language (as symbols avoid use of any linguistic expression). This was particularly an asset to India where there are so many regional languages with their own distinctive scripts.

BUREAU OF INDIAN STANDARDS

Around the later half of the eighties, the status of the Indian Standards Institution was upgraded to that of a statutory body and it was redesignated as the Bureau of Indian Standards (BIS). In the reorganization of work, the activities of the Documentation Sectional Committee were placed under the charge of the newly created Management and Systems Division Council (MSD). Earlier, as the work of the Documentation Committee had expanded, a separate Sectional Committee had been created to guide development of standards in the field of publications and graphic technology. Standards concerning library furniture and fittings are developed separately by the Furniture Sectional Committee (CED 35) working under the Civil Engineering Division Council. Uptodate position about the standards formulated by these committees is given in Appendices A, B & C.

INTERNATIONAL INTERACTION

The International Organization for Standardization (ISO) which has a mandate to develop and make available standards for use internationally too came to be established around 1947 after World War II. ISO too had constituted a Technical Committee for Documentation (ISO/TC 46). During its formative years, this ISO Committee also drew considerably upon the personal genius and insight of Dr. Ranganathan. On behalf of India, Dr. Ranganathan participated in the meetings of ISO/TC 46. All the documents emanating from the ISO Documentation Committee were studied minutely, commented upon in detail and in some cases even revised proposals were submitted which were accepted as substitute for the original proposals. The ISO standards at the time followed the development of Indian Standards and invariably drew upon their contents. Particular mention can be made of the following standards which provided the blue prints for the corresponding ISO standards:

IS:4-1949 Practice for Make Up of Periodicals, and
IS:18-1949 Abbreviations for Titles of Periodicals

Similarly, the series of Indian Standards on the title pages of a book had provided the basic reference documents for developing the corresponsing ISO standards. Presently, with the advent of the automated systems of information retrieval, ISO work has stolen a march on India in the post Ranganathan era. It is, therefore, a challange for the current generation of documentalists to take note and wrest the lead once again.

PROMOTION OF STANDARDS

Apart from formulation of standards, Dr. Ranganathan was also working energetically to ensure proper enforcement of the standards. Because unless the standards formulated are implemented, the effort spent in their development has no meaning. Dr. Ranganathan, therefore, made it a point to draw attention to the standards through press, publications and platform. As soon as a topic was taken up for standardization, Dr. Ranganathan would write about it in professional journals to invite views and comments. As soon as a standard was published, he would repeat the exercise to stress the need for adopting the standards for the sake of adopting uniformity of practice and deriving inherent advantages of economy and efficiency.

The topics connected with standardization in documentation were featured at his instance at various meetings of the professional bodies like the Indian Library Association, Indian Association of Special Libraries, etc. The Indian Standards Institution itself at the time was organizing Annual Conventions. These were big affairs spanning 4-5 days of intensive deliberations and receiving participation from over 5 hundred top professionals drawn from all parts of the country. Dr. Ranganathan saw to it that these conventions also featured themes having relevance to the work of documentation and information retrieval. The programmes for such theme sessions were meticulously planned with authors assigned the responsibilities for submitting papers in advance which were whetted by Dr. Ranganathan himself. The deliberations were sifted minutely to bring out a set of action points which were adopted as policy guidelines till their revision at the next Convention Session.

IN RETROSPECT

I had the good fortune to come in close contact with Dr. Ranganathan for a decade spanning the sixties. I had just joined the Indian Standards

Institutuion and was assigned to the Publications Department then under the charge of Shri Jainath Kaul, an acknowledged stalwart of the profession at the time. Dr. Ranganathan, Shri Jainath Kaul, Dr. Lal C. Verman all shared a common trait of giving their best to the assignment at hand and never became satisfied with the second best. I was just a fresher and a green horn. But it testifies to the greatness of these souls that no one was conscious of age factor or rank factor at any time. We worked as a team and every proposal, suggestion or viewpoint was considered at its own merit.

Working with them has been one of my most valued experience in life. They did not spare themselves and as such gave no quarters to others. If a job had to be done, it had to be done unmindful of lateness of hours and strain of comfort.

I recall an incident in which Shri Jainath Kaul and myself had to beat a deadline to finalize and make available certain documents. We had been working without let up and did not know how the time flew. Suddenly, it was 8 p.m. Shri Kaul noticed it and enquired if I was hungry. I was not particularly hungry but was feeling a bit tired. I knew that an hour's work still needed to be done on the documents. But sensing an opportunity to escape, I told Shri Kaul that I was indeed feeling hungry. My calculations were that we would call it a day and subsequently at home I could complete the work and bring it to the office the next morning. But I was in for a surprise as Shri Kaul opened a box containing roasted grams and said we could share it and have a glass of water as we could not afford to slacken our effort. Perhaps that is what they call 'Strike the iron when it is hot'.

I have seen both Dr. Ranganathan and Dr. Lal C. Verman working late into nights. Dr. Ranganathan was of a frail build but would still work till 11 p.m. sitting in chair. Then he would be too exhausted to sit. He would, therefore, recline on a bed but would continue till well past mid night. He will be up before dawn, out for a morning walk with a band of his associates discussing only the intricacies of documentation theory and practice.

Dr. Ranganathan combined in his person all that is regarded as best by way of human qualities, frugality, self-denial, generosity, affability and total dedication to his mission. He was extremely modest in his dress mode and simple in his diet. All he needed was a few spoons of rice and a glass of butter milk. He had donated his life's savings to create a chair of Library Science in Madras University. The royality from his books also went to a library asociation as donations. For his upkeep, he made to do with a pension of only Rs. 200-300' he was receiving from the Govt of India as part of the Padma Shri Award conferred up on him. In his life time itself, honours and recognition had started pouring thick upon Dr. Ranganathan for his work and contribution. But he remained unspoilt to the last - a gentle, cheerful, unassuming soul wishing well to one and all. His glorious example of dedication and selfless service is bound to be a source of constant inspiration to the generations of librarians, documentationists and information scientists in all times to come.

APPENDIX A

STANDARDS FORMULATED BY THE DOCUMENTATION SECTIONAL COMMITTEE

1.	IS 18: 1988	Documentation - Rules for the abbreviation of title words and titles of publications (second revision)
2.	IS 382: 1952	Practice for alphabetical arrangement
3.	IS 795: 1976	Guide for preparation of abstracts (first revision)
4.	IS 796: 1966	Glossary of cataloguing terms (first revision)
5.	IS 1275: 1976	Rules for making alphabetical indexes (first revision)
6.	IS 1358: 1967	Practice for layout of library catalogue code (first revision)
7.	IS 2381: 1978	Recommendations for bibliographical references: Essential and supplementary elements (first revision)
8.	IS 2550: 1963	Glossary of classification terms
9.	IS 3083: 1985	Code of practice for the processing of microtransparencies (microfilms and microfiche) (silver halide) (first revision)
10.	IS 3130: 1985	Code of practice for handling and storage ofmicrotransparencies (microfilm and microfiche) (silver halide) (second revision)
11.	IS 4731: 1968	Guide for preparation of manuscript of an article in a learned periodical
12.	IS 6299: 1971	Guide for handling, testing and storage of monochrome photographic prints
13.	IS 6666: 1972	Recommendations for frequency notation for periodical publications
14.	IS 7150: 1974	Specification for library catalogue and abstract card
15.	IS 7900: 1976	Method for writing calendar dates in all numeric forms
16.	IS 8310: 1977	Guide for standard book numbering
17.	IS 9400: 1980	Guide for the preparation of bibliographic description sheet for technical reports
18.	IS 9450: 1980	Guidelines for placement of images in roll microfilm
19.	IS 10101: 1982	Guide for International Standard Serial Numbering (ISSN)
20.	IS 10200: 1982	Specification for A6 size microfiche
21.	IS 10454: 1983	Guidelines for presentation of translations
22.	IS 10455: 1983	Guidelines for presentation of abstract sheets in serial publications
23.	IS 10456: 1983	Specification for density of silver-gelatin type microforms
24.	IS 11370: 1985	Guide for data elements and record format for computer based bibliographical data bases for. bibliographic description of different kinds of documents
25.	IS 12879 (PT 1): 1990	Microfilming of technical drawings and other drawing office document Part 1. Operating procedures
26.	IS 12879 (PT 2): 1990	Microfilming of technical drawings and other drawing office documents. Part 2. Quality criteria and control
27.	IS 12879 (PT 3): 1990	Microfilming of technical drawings and other drawing office documents. Part 3. Unitized 35 mm microfilm carrier
28.	IS 12940: 1990	Documentation - Library statistics - Guide

THEMES IN PIPELINE

1. Transliteration of Indian languages into Roman script
2. Guidelines for preparation of a thesaurus (based on ISO 2788)
3. Recommendations for entries in a directory of periodicals
4. Library forms and records
5. Items of information and layout of an entry in a union catalogue of periodical publications
6. Proforma for recording information on ongoing reseach projects at the institutional level and at the national level
7. Directories of libraries, information and documentation centres (based on ISO 2146)
8. Recommendations for numbering system of reports
9. Data elements and data structure for computer readable data

APPENDIX B

STANDARDS FORMULATED BY THE PUBLICATIONS AND GRAPHIC TECHNOLOGY SECTIONAL COMMITTEE

1.	IS 4: 1963	Guide for layout of learned periodicals (Revised)
2.	IS 12: 1988	Guide for drafting and presentation of Indian Standards (third revision)
3.	IS 790: 1987	Guidelines for preliminary pages of a book (first revision) incorporting IS 791: 1956, IS 792: 1964and IS 794: 1956)
4.	IS 1250: 1958	Proof corrections for printers and authors
5.	IS 3050: 1965	Code of practice for reinforced binding of library books and periodicals
6.	IS 6298: 1971	Guide for selection of type and page layout in textbooks
7.	IS 6660: 1972	Guide for illustrations in books
8.	IS 7140: 1971	Symbols and notations for correction of illustrations and illustration proofs
9.	IS 7160 (PT 1): 1974	Guide for print area, margins and type sizes for textbooks. Part 1. Textbooks in English
10.	IS 7160 (PT 2): 1974	Guide for print area, margins and type sizes for textbooks. Part 2. Textbooks in Hindi
11.	IS 7160 (PT 3): 1974	Guide for print area, margins and type sizes for textbooks. Part 3. Textbooks in Malayalam
12.	IS 7160 (PT 4): 1977	Guide for Print area, margins and type sizes for textbooks. Part 4. Textbooks in Telugu
13.	IS 7160 (PT 5): 1977	Guide for Print area, margins and type sizes for textbooks. Part 5. Textbooks in Kannada
14.	IS 7160 (PT 6): 1977	Guide for print area, margins and type sizes for textbooks. Part 6. Textbooks in Tamil
15.	IS 7160 (PT 7); 1980	Guide for print area, margins and type sizes for textbooks. Part 7. Textbooks in Bengali
16.	IS 7400-1974	Guide for preparation and production of textbooks
17.	IS 8010 (PT 1): 1976	Guidelines for preparation of technical reports. Part 1. Research and development reports
18.	IS 8010 (PT 2): 1982	Guidelines for preparation of technical reports. Part 2. Feasibility reports
19.	IS 8010 (PT 3): 1987	Guidelines for preparation of technical reports. Part 3. Industrial potential survey reports
20	IS 9637: 1980	Guidelines for presentation of information in technical manuals
21.	IS 11956: 1987	Guidelines for the preparation of trade catalogues
22.	IS 11957: 1987	Guidelines for contents list of periodicals
23.	IS 12000 (PT 1): 1987	Guide for paper spoilage and wastage for printing industry. Part 1. Sheetfed, letterpress and offset processes.

THEMES IN THE PIPELINE

1. Glossary of terms relating to printing and publishing. Part 1. Printing technology
2. Glossary of terms relating to printing and publishing. Part 2. Relief printing
3. Glossary of terms relating to printing and publishing. Part 3. Planorgraphic printing
4. Guide for print area, margins and type sizes for textbooks. Part 8. Textbooks in Assamese
5. Guide for print area, margins and type sizes for textbooks. Part 9. Textbooks in Oriya
6. Guide for print area, margins and type sizes for textbooks. Part 10. Textbooks in Punjabi.

APPENDIX C

INDIAN STANDARDS FOR LIBRARY FITTINGS AND FURNITURE

1.	IS 1829 (Pt I): 1976	Specification for library furniture and fittings. Part 1. Timber.
2.	IS 1883: 1983	Specification for metal shelving racks, adjustable type (Third Revision)
3.	IS 1829 (Pt 2): 1977	Specification for library furniture and fittings. Part 2. Steel
4.	IS: 2695: 1974	Specification for drawing filing equipment (First Revision)
5.	IS: 3312: 1984	Specification for steel shelving cabinets (adjustable type) (Second Revision)
6.	IS: 4116: 1988	Specification for wooden shelving cabinets (adjustable type) (First Revision).
7.	IS: 7076-1983	Specification for metal book ends (First Revision).
8.	IS: 7761: 1983	Specification for steel book cases (First Revision)
9.	IS: 8467: 1977	Specification for steel card-index cabinets
10.	IS: 9715: 1981	Specification for steel visible indexing system cabinets

THEMES IN PIPELINE

1. Specification for wooden card index cabinets
2. Data Processing card cabinets (for computer)
3. Specification for library furniture and fittings. Part 3. Non book material.

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CREATIVITY IN THE THOUGHT OF Dr. S. R. RANGANATHAN

GIRIJA KUMAR
Chairman
Indian Organizing Committee for IFLA, 1992

RELIGIOUS AND CULTURAL BACKGROUND

Dr. S. R. Ranganathan had two sides to his conceptual make up-his intellectual being which was essentially Western oriented and his cultural being which was rooted deap in tradition. His adherence to scientific methodology established his bonafides as his being a part of the mainstream. His intellect cut across national boundaries. He could be classed with Dewey, Cutter and Bliss with ease. His cultural background could be incidental to his contribution to library science.

However, it is equally inadvisable to draw him away from his roots. The cultural influences are prominent in his thought. His manner of presentation of situations is essentially brahmanic.

Dr. Ranganathan was very fond of picking analogies from the Indian religious scriptures for supporting his argument. Ramayana was his favourite. His references were essentially illustrative and at times not necessarily directly relevant for supporting the argument. At times, these were also discursive. It was thus difficult to weave his Indian illustrations into the essence of the argument.

A PRAGMATIST

Dr. Ranganathan was a pragmatist at the bottom of his heart. Those who talk of him as a mystic and an Indian seer may not be doing justice to him. It does not reflect the true reality. He was not particularly a religious man. He was at the most a practising Hindu.

His frequent references to Indian mythology are not necessarily his strong points. He may in fact be arguing from a weaker position in those circumstances. There is, however, no way of dispelling widely believed myths except to wait for a time to come and apply its healing touch. Marcia H. Chappel is a perceptive critic of Ranganathan but when it comes to his essentially Indian character and its dominant effect on his thought, she drops all deferences to state, "Ranganathan's approach to librarianship is fundamentally not scientific but religious in the broadest sense of the term. In his discussions of reference service he frequently refers to the metaphysical and moral contents that define the place of librarianship within the social order". She is also sure about the influence of Hinduism on the integrative approach and value system[1].

THREAT OF RENUNCIATION

What chappel has suggested is no more than a hearsay. Those who had close association with him like the members of the Classification Research Group, knew him better. D. W. Langridge, for instence, has mentioned Dr. Ranganathan's experiments in extra sensory practices in communicating with the spirits. There are moving references to his two seances in communicating with dead Ramanujan, the great Indian mathematician, in which his spirit affirms all loss of interest in mathematics after his death [2].

Dr. Ranganathan had edited a book on spiritual seances in his early days. The book was published anonymously. He defended his position arguing. "In those days, it was difficult enough trying to persuade people in India that librarianship was a reputable profession, without the added handicap of occult connections" [3].

Similarly, there is an urge for spiritual experience as reflected in his biographical writings. Whenever he felt depressed in his life, he had thought of renunciating the world. It does not, however, mean much. Renunciation is always at the back of the mind of a good Hindu. It is a part of his subconscious being. No harm is ever done. He communicated with his Guru on renunciation from time to time and got the same reply, "You can't do it in this incarnation. You must continue your work and writing, and perhaps think of renunciation in the next life" [4]. Such a piece of advice must have proved to be a psychological palliative to him.

RANGANATHAN AND MYSTICISM

Religion was a part of his personal being. Hinduism being a catholic faith with no central authority or common belief did not enjoin upon him to employ religious traditions in the context of his intellectual thinking. Religion was for the individual. The library scientist in him was a personality of different order. He had himself categorically derived having passed through any "real mystic experience". He has also denied vehemently any association of religious thought with his theory of library classification.

In fact he seems to admonish the author of the piece of writing about mysticism and classification. He has asserted that "a classification scheme should not get consciously involved in intellectual entities of that kind, i.e. mysticism" [5]. Langridge is right when he asserts in defence of Ranganathan, "Much as he appreciated the significance of mysticism, Ranganathan was not himself a mystic. He was an intellectual who absorbed much from the West and united us all in the application of scientific method to librarianship. Religious beliefs and ideas are not apparent in his works as one might expect; though he does quote effectively from Hindu classics" [6].

INDIAN SCRIPTURES

Ranganathan is very fond of quoting from Indian scriptures. The references are mostly ornamental and for effect upon the uninitiated. Being a child of Indian nationalism, he is impelled to flaunt his separate identity distinct from the rest of the world. His brahmanic background makes him emphasize his moral duties to others which he takes rather too seriously. Dr. Ranganathan had a number of good friends. Prof. S. Kuppuswami Sastriar, the great scholar of Indology, was one of them. He must have benefitted by the contact with the Sanskrit scholar. He owes many of his ideas drawn from Hindu scriptures to him. The Principle of Unity of Idea referred to in the 'Prolegomena' [7] was brought to his attention by the professsor.

Dr. Ranganathan's theoretical writings are indeed impressive. He is said to be the Pope of Library Classification. His writings on classification are looked upon with awe. His earlier writings are entirely of a different genre. He is essentially a garrulous being. In the true Indian tradition, he finds himself at home narrating endless stories. None is complete without a moral.

His "Five Laws" [8] and "References Service" [9] are most adept in the techniques special to the art of story telling. The chapter on the Second Law in his "Five Laws of Library Science" makes the most delightful reading. It is in the form of the Socratian dialogue. Equally readable is the Sambandhar epidsode, based on a folk tale drawn from his native Shiyali. Shambandhar lived in the seventh century. Upon finding the gates of heaven open by sheer accident, he had the good sense to help everyone from his village to slip beyond the portals of heaven. The moral of the story was "in its expression of universal brotherhood, serene as a symbol of the Second Law of library science' [10]. The analogy is far-fetched, but it establishes the humanistic tendencies of the earlier Ranganathan.

THE SPIRIT OF THE LIBRARY

Ranganathan felt at the top of the world in his earlier years. Intellectual activity brought him pure joy. His work on reference service is significant on that account. His *joie de vivre* is definitely communicated to others. He feels like a free bird soaring high in the sky. He sings of "the spirit of the library".

In those years his intellect was devoted to a missionary cause. He was envisaging a network of public libraries spread all over the country. Besides reference service, public library service was another facet of librarianship that concerned him. The medieval seers, viz. Sankara and Ramanuja Acharya have always talked of God in terms of attaining knowledge. In other words only through knowledge *('gyana')* comes enlightenment. To Ranganathan, library became an instrument of enlightenment. He was thus unintentionally employing the modern concept of human resource development by talking of spirituality. This is what he precisely meant by "the vital principle". It would, however, be wrong to read more meaning into his employment of religious symbolism. His religiousity was of the normal type. Religion was a convenient tool to make a point. In his elaborations, he often talked of the "Inner Man". Many secular thinkers today are also equally concerned with the "Inner Man". Humanism is increasingly coming to be accepted as an intellectual discipline.

Ranganathan was far sighted because he used to speak of what was to become the talking point of the subsequent times:
"....... The vital principle of the library .... which has struggled through all the stages of its evolution, is common to all different forms and will

persist to be its distinguishing feature for all times to come ..... is that it is an instrument of universal education, and assembles together and freely distributes all the tools of education and disseminates knowledge .....". This vital principle, " the spirit of the library" - persisting through all its forms is like the Inner Man; and to it are applicable the words of Lord Krishna in Gita.

ANALOGIES AND THREE PLANES

Analogies have provided Ranganathan with the freedom of intellect. Hey presto, like a magician pulling rabbits out of a hat, Ranganthan puts solutions to seemingly unsoluble problems by falling back upon analogies drawn from Indian scriptures. Whether these are appropriate or not, they make a telling effect. His metaphysics is a convenient tool for him twisted and turned around to suit the convenience. It is like Alladin's magic lamp performing upto his will. The analogies from Indian scriptures are indeed post-facto justifications for conclusions he seemed to have arrived at by the sheer force of his intellect.

In Indian tradition, the numeral three is of great significance. Ranganathan seems to make a great use of the same. The whole foundation of his theory of library classification is based on three planes at the idea, verbal and notational levels. In his metaphysical analogy, the living body also consists of three categories; i.e. soul, subtle-body and gross body. The soul is placed at the highest pedestal. It has to do with the primary senses beyond the ordinary intellect. Ranganathan in his writings has talked of creativity being attained through the process of intuition. Creativity has to do with the primary senses. Similarly, the other two planes at the notational and verbal levels have to do with intellectual experiences. They are somewhat akin to "subtle body" and "gross body". He relates all this to the 'vital principle of library'. Again a three-some game is played by him. He talks of three planes of human existence:

a) the 'Vital plane',
b) the 'Mental plane' and
c) the 'Spiritual plane'.

The 'Vital plane' is intended to fulfil the gross needs of the body. This is precisely the function performed by the library. It draws sustenance from the 'Mental plane' concerned with the intellect. Ranganathan himself had operated at the 'Mental plane'. The 'Spiritual plane' was not for him in this life. He has talked of "Pure existence-cum-pure-consciousness-cum-pure delight", [12] thereby overlaying the essence of his thinking with metaphorical references derived from Indian metaphysics. "The vital principle of the library" in his perspective is intended to envisage a humanistic core for library science. The essence of Hinduism may lie in the universal harmony. Its slogan of the 'world being one big family *('Vasudtaiv Kutambkam')* is most appealing. Ranganathan has certainly found analogies for librarianship from fundamental principles of his religious faith. The religious idiom in his instance has definitely a secular face.

INTELLECTUAL ESSENCE

Ranganathan employed references from religious scriptures and philosophic treatises to support his arguments. It was essentially an intellectual exercise. It was a commendable effort even though his knowledge of Indian tradition was not based on deep study of Indian classics. He was essentially an intellectual and not a religious being. His applications into Indian traditions were to discover his roots. Not too much should be read into it. Apparently his knowledge of Indian tradition was acquired by contact with others like his friend Prof. Kuppuswami Sastriar. It was his instinct that led him to the explanations.

It is fascinating to view Ranganathan as an essentially intellectual being. Library science is to be viewed as secondary in his scheme of things. He was perceptive in recognizing the teachings of the *Upnishads* in that the essence of man was intellect and accordingly, "The intellect is restless. It cannot help recalling the pursuit of abstraction at higher and higher levels. The innate urge is irrepressible. It looks for every field to feed on. It finds joy in working in abstract fields of every kind. Classification presents one such field in the field of abstract classification" [13].

To him library classification was an intellectual adventure. His intellectual proclivities came out into the open. His world view is thus sanctified by the support drawn by him from ancient philosophical treatises of India.

The sustenance of his thought thus comes from Indian philosophy rather than religion. The best of his analogies drawn from the Indian tradition have a philosophical purport. The confusion arises in the minds of Western readers due to their inability to differentiate religion from philosophy. The task is somewhat complicated by the fact of symbiosis between religion and philosophical thoughts in Indian tradition. The writings of Ranganathan to some extent reflect the situation.

EKAVAKYATA PRINCIPLE

There are several philosophical concepts drawn from Indian tradition finding their place in the thoughts of Ranganathan. The fundamental concepts include the principle of *Ekavakyata* (integrative interpretation), the Principle of unity of idea and the laws of interpretation. *Ekavakyata* is most fundamental in his thought. The principle of unity of idea in which the sentences, paragraphs and chapters of a "book fall within a single sweep of comprehension" has been actually practised by him in his writings. The notational representation with zero in the end and based on systematic classification is also drawn from the Indian tradition. It seems to support the principle of *Ekavakyata* in actual practice.

Similarly the laws of interpretation have been employed by him in his theory of library classification. These principles have been widely applied in interpreting legal texts. To him, "the canons, the principles and the rules for classification taken together look like a legal work" [14]. When a conflict arises, it should be resolved with the help of the Laws of Interpretation. He is even prepared to admit that "the rules - and less frequently, even the principles and the canons should be ammended in the light of experience so as to remove old conflicts and reduce new ones to a minimum" [15].

Theoretically Ranganathan is prepared to admit that his conceptual framework is subject to reform. It needs to be restructured keeping in view the latest developments in the field of knowledge and information needs of users. So his conceptual framework could work out to be an open-ended system.

Bliss has accused Ranganathan of stealing the principle of synthesis from him without due acknowledgement. Ranganathan has however, made much play of drawing inspiration for his holistic principle from the Vedic principle of *Ekavakyata*. The concept is basic to his thought. In a manner of speaking, the unity of thought comes with mother's milk to Hindu children especially those born and bred in brahmanic tradition. To some extent his teacher of mathematics Edward B. Ross inspired him in this direction. His own mathematical background trained him in this attitude of viewing the world and its phenomena integrally. His early obsession with the *Ekavakyata* principle is reflected in a stanza from a poem by Francis Thompson:

All things by immortal power
Near or Far
Hiddenly
To each other linked are,
That thou canst not stir a flower
Without troubling of a star

The generation to which Ranganathan belonged was discovering India via-Europe. The *Ekavakyata* principle had a special appeal to German thinkers, philosophers and poets. Mysticism had also great appeal to English poets like William Morris. All this debate about an integral world view impressed the generation of Dr. S.R. Ranganathan to no end. It, however, came second hand to his generation.

His basic thought owes to the fundamental concepts of mysticism, intuition and *'Ekavakyata'*. These are overloaded with metaphysical references obscuring the real intentions of Ranganathan. He is essentially a pragmatist clothing his argument in a theoretical framework. The integrative world view has come handy to him. He makes effective use of the thesis raising his pragmatism to the level of integrated model.

HOLISTIC PRINCIPLE

The *Ekvakyata* principle was definitely in his mind while he travelled to Great Britain. He saw a practical demonstration of it in the "British library world". Those experiences were absorbed and were illuminated in his future works. This is what had impressed him the most in British experience. He had realised that "even apparently trivial occurrences are organically fused into a single life-experience. Occasionally when immersed in thinking out ideas, all the long years of life fuse into one" [18].

The most concrete form of the principle was manifested in his five laws of library science, which according to him are "a verbal record of the *"Ekavakyata"* of library practice and science, as it revealed itself" [19]. Here Ranganathan finds himself in the role of a self proclaimed prophet who has the benefit of revealation in an early stage of his professional career.

The holistic world view is indeed so integral to his thought that it is next to impossible to view him independently from it. Whether it is five laws, canons, postulated approach, symbiosis between classification and cataloguing, the concept of unity of thought was uppermost for him. The primodial idea sums up Ranganathan and his thought in one word. The dialectical situation favouring him has come about for his deep roots in the Indian tradition. He has to be largely credited for realizing its far reaching implications.

INTELLECTION

English equivalence of *Ekavakyata* is holism: The literal meaning of the term is "the whole is greater than its parts". Ranganathan may have discovered the English equivalent from the writings of the great South African statesman General Smuts, who wrote a book on the subject of holism. Ranganathan may have found support for his concept of intuition from the same source. Intuition has been called by General Smuts as "this region of knowledge", no man's zone for intellection" [20].

Ranganathan was also fond of the term intellection. There are frequent references to intellection in his writings. It is self evident by now that the terms holism, intuition and intellection have been employed by Ranganathan as they are found in literature of mysticism. The concept of holism is not exclusively used in the literature of mysticism. It is employed widely in the context of knowledge in entirely different connotations.

Dialectics have much use for the concept. The change of quantity into quality resulting in a totally different product or concept is widely recognized in the literature of dialectics. The whole superstructure built by Karl Marx is based on the unity of concepts at the subterranean level, with one closely allied to the other, impacting the conceptual framework with change in situation and evidently ending up as an entirely new and rebuilt conceptual framework. The process is endless and repeated from time to time. The contribution of Ranganathan lies in relating it to the Indian tradition and providing an entirely new thrust to the discipline of library science.

CREATIVITY

Ranganathan has given a great deal of thought to all generation of creativity in geniuses. He was very much self-conscious about his contribution to history. He definitely considered himself a creative being. He was thus anxious to reach the roots of creativity. The five laws were certainly the most creative experience for him. He formulated the five laws in their proper manifestations in 1928 when he was forty. Melvil Dewey invented Decimal classification in 1876 when he was barely twenty five. Shankracharya became creative by the time he was seven.

Buddha, Christ and Muhammad reached their prime when they were in their adolescence, the scientists are creative while they are in their twenties. Creativity is a late starter among social scientists. Ranganathan became creative when he was middle aged. The creative period in him lasted briefly for just five years, that is from 1928 (with the discovery of five laws) to 1933 (publication of colon classification).

Ranganathan has viewed creativity as a mystic experience. He has attributed creavity to intuitive processes. He has sought to make a distinction between "intellection" and "intuition". While the former is considered as "rationalistic", the latter is related to "mystic experience". Intuition is considered of much higher order than intellection. In his view, there is a realm to which intellect cannot hope to aspire. Creativity is thus the domain of intuition. It is also beyond the reach of scientific method which is good enough for intellectual experiences.

Ranganathan has given equal attention to the subject of intuition. He has, however, not taken into account any literary, sociological or psychological writings in contemporary literature on the subject. What C. Wright Mills has termed "sociological imagination" has not been taken into account by him in his writings on intuition. He has entirely based himself on the Indian tradition on mysticism. He is so much obsessed with the subject that he turns back to it again and again. Here Ranganathan seems to enter the domain of metaphysics with hands and feet tied together. There is, however, a saving grace in all this. He is in the situation of famous Moliere character who had spoken prose all his life without realizing it. There are psychological truths with hidden meanings to be found in verbiage.

Some of his writings on intuition are extraordinary. He lets himself go which is rare in normal circumstances for him. His prose assumes a coloration when he begins to talk of intuition. Not only the mystical experiences, but the very mention of it transforms the man. The term used for intuition in Sanskrit tradition is *Divya Chakshus* (divine insight). Ranganathan seems to be overpowered by this faculty whenever he mentions the term intuition. He has speculated a great deal about it. The spiritual communion in his view approximates to intuitive experience. The literary communion is of the nearest approximation to spiritual communion. The truth is discovered momentarily in a flash. The experience is best described in his own words "when one is engaged on a problem, the most useful ideas occur suddenly. They seem, at once; to cast a flood of light over murky tracts of half formed thought and promise reward to further exploration, This has been my experience and it is doubtless shared by many others. These surprise ideas present themselves as ready made vehicles coming at the oddest moments. They seldom come if they are sought and get delight in choosing moments when pen and papers cannot be used to impede their flight. They come and whisper in our ears as we are sleeping in bed or as we mechanically repeat a long drawn-out hymn as part of the daily routine of worship" [21].

Surprisingly similar experiences have been related by other creative beings in other fields of knowledge. Ranganathan was thus in the mainstream while operating in the narrow field of library science.

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RANGANATHAN'S APPROACH TO KNOWLEDGE ORGANISATION AND ITS IMPACT ON MODERN LIBRARY AND INFORMATION SERVICES

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Analyses the basic approach to knowledge organisation. Identifies the basis of analytico-synthetic approach of Ranganathan. Delineates this approach in relation to information seeking, information science, information resource management and information dissemination and retrieval. The analysis further leads to the professional expertise in knowledge base communication and education for the same. Ranganathan's approach moves in from fundamental to empirical analysis.

KNOWLEDGE ORGANISATION

Knowledge is a mental entity. It is the totality of ideas that are evolved out of human mind from different times and climes. It is the preserver of human civilisation and culture. Knowledge results from the interaction of human beings with the nature and surroundings. The natural basis of knowledge is extended by the human observation power. Knowledge by itself does not have any shape. It is the human intellect which organises itself into different modules for absorption and use at different stages. Recorded knowledge is given in modules convenient for absorption by the human mind. For the purpose of learning, teaching and utilisation, knowledge is given specialised structure so that concentration is bestowed on problems in an intensive manner. The learning, teaching, research when it becomes mission-oriented becomes integrative and fragmented in a variety of manner. The variety of ways in which knowledge can combine is dexterously turned to advantage for creativity by individuals or groups of individuals.

FEATURES OF KNOWLEDGE ORGANISATION

Knowledge organisation (=KO) thus connotes a kind of logical separation and yet integrates with whole of knowledge. It is a kind of progression in which a person concentrates on a spot of thought in the context of whole knowledge. It may be an area or a system, or an environment or anything. It is the study of an object or a concept in relation to its surroundings. KO plays to focus many things to satisfy specialists. Ranganathan said that "periods of rapid and extensive development of a discipline are frequently periods of loose thinking about its foundations. The recognition of the need for a catastrophic change of the foundation emerges rather slowly. Such was the case of mathematics in the eighteenth century and with biology in the nineteeth. So, it is today with classification at the levels of idea and notation alike. With a sort of perverse professional modesty, many evade facing the problem by insisting that they classify in relation to the particular set up of their respective libraries without too intimate a reference to the happenings in the field of knowledge either in the superficies or at varying depths' [4].

Ranganathan thus emphasized the role of classification in organisation of knowledge. Such structures depend upon models of thought. Just as in trying to restore a multi-dimensional object a number of projections must be combined, so in dealing with anything as complex as human society we have simultaneously as many different kinds of models as possible. These must cover the whole gamut commencing from examining how much we are the prisoners of our decisions. Different models provide different decision-support. They generate alternative modelling of information. The key to geting a variety of models is producing scientific groups of subjects related horizontally such as chemistry, biology, physics or mathematics or even subjects such as economics, politics, and sociology. However, in the real life situation there is a criss-crossing of scholarship which may work in different directions. This leads to an axiom that knowledge is one. Its division into subjects is a concession to human weakness and strength. It leads to intellectual team work.

On this, Ranganathan says "the cooperation between philosphers and physicists, which has emerged from the physical thesis of quanta and fundamental particles, is remarkable testimony to the cooperative intellectual work which has now come into vogue. The process of cleaning, dress-ing and distilling has called for great changes in the auxiliary disciplines of logic and epistemology. Indeed the amount of new thought which is being forged by large teams of workers in the field of logic is amazing. General semantics and logical syntax are the result of teamwork among Polish and American thinkers on that subject" [2].

On the basis of these premises Ranganathan developed an analytico-synthetic approach. According to him "The unprecedented atomisation of thought-mass being brought about by intellectual teamwork has emphasized the need for invoking the aid of a faceted, phased, structurally expressive, analytico-synthetic classification in the area of reference service. The onslaught of atomisation which threatened to break down communication even among persons engaged in the same piece of intellectual teamwork was being pursued. Subject specialists were, therefore, put in charge of research records, which are what records embodying atomised thought amount to. No doubt some relief did come by this remedy - but not full relief. This is because the correct etiology is not that the library staff did not have specialised knowledge but that its tool to facilitate communication viz., classification was not sharp enough to do the job. Once this is recognised the need for research within the domain of classification in communication will be realised" [3]. Thus, analytico-synthetic approach provides a multi-dimensional object analysis for a knowledge communicator. The basic structure of this approach may be further delineated as follows:

Analytico-synthetic approach

1) Focusses attention of an observer on a field of knowledge, however broad or narrow it may be. The knowledge may be over an object, a property of it, or an action or its environment. It helps an observer in intensive probing of a field of knowledge. It assists in filtering the relevant from the non-relevant.

2) Integrates in a manner conducive to human thinking any broad or narrow field to its related field of knowledge. It presents a semantic mapping of knowledge centering round any one piece of knowledge. It helps in browsing and contextual interpretation of knowledge.

3) Sets a pattern of arrangement of ideas to facilitate the formation of consistent structuring of subjects. This helps in precise communication of knowledge.

4) Provides for a kind of symbol manipulation for representation of concepts, for ease of arrangement of ideas and their ensembles in a helpful sequence. This catalyses the process of information retrieval.

5) Provides for guidelines for the presentation of ideas in a goal-oriented or target audience oriented presentation of information. This catalyses the process of assimilation of relevant information.

This analytico-synthetic approach provides a classificatory language and a frame for knowledge organisation. Such an organisation of knowledge should be empathetic to information seeking, access, dissemination and use.

The activities are different aspects of a communication process. Classification that is representation of knowledge is a lamina in this communication. Classification assists any communication process. It provides a frame of reference to any person for the study of information and communication environment. The new role of classification in information transfer is to act as filter for information flood. In other words, it organises and integrates the increedible rich body of information representation such as visual image and audio tape. Creative process in fusion with flexible classification process can produce knowledge of high utility value. It dowers a personality. Classification synchronised with human personality will trigger a dynamic structure of knowledge. Prof. Ranganathan talks about the "dowering with life energy". "Any how mechanised things are dependent upon the use for beauty.

A turbine at work is a thing of wonder and beauty; but out of use, it is dearer than it was before its elements were taken from earth. Because of this need for redeeming use, the multitude of mechanisms, surrounding us may justly be regarded as appealing objects making persistent demand upon us. May, because of their inanimation, they threaten us with the sense of death unless they are continuously dowered with our own life energy" [5].

Speaking about the human agency to redeem, Ranganathan wrote, "Hence the need for introducing a human agency to redeem everything else by putting them to active use. When the reader comes amidst the library, there must be some one to say, "Take my hand; for I have passed this way. And know the truth". .... If such a human personality is not provided, the potentially great works in the holdings of the library of today will be nothing but a mockery. Indeed the problem in libraries is no longer one of scarcity in a sense, except that of scarcity in the human converter of the potential energy of books, mouldering on shelves, into kinetic energy of use by readers. This, in its turn, is due only to scarcity of initiatives in high places and of understanding generally. "..... So far as knowledge is intutive or hereditary, the need for reference service will not be seen. But with our present insistence on equality of opportunity for information, knowledge and inspiration from the sublime thoughts of men of genius, reference service becomes essential to national progress and efficiency through democratic methods. There can be no true democracy without reference service." [5]. Classification provides a structural basis for dynamic reference service.

EMERGING DIMENSIONS

In the context of information seeking, access and retrieval, the emergent dimensions of library and information profession are as follows:

1) Scientific approach concerned with the theories and experimentations dealing with communication, information and information systems and processes in the systems;

2) Technological approach with the application of information technology to handling of information;

3) Professional approach (applied, Pragmatic), concerned with information system/services/networks/use/utility and user needs/demands, etc.

These problems were further accentuated by a set of new developments, particularly from the seventies.

1) The spectacular advances in micro-electronics, telecommunications, media technologies, and their application to the information field and the resultant political, social and legal implications.

2) The concept of information society where in the axial principle is the centrality of codified theoretical knowledge as a determining key factor for innovation and policy formulation.

3) Information needs in different contexts, such as policy-making, planning, decision-making in a variety of situations, specialised needs for information for industry, energy, environment, health, etc.

4) Problem-solving, which demands the integration of scientific, technical and technological information with societal information.

5) The development of information industry, the related problems of economics and sociological aspects.

The discipline of library and information science concerns itself with

1) Generation and growth of information in different environments;

2) Collection, storage, organisation and processing of information and facilitating its access and use;

3) Dissemination, Diffusion and transfer of information in different user environments;

4) Use, abuse, and impact of information on individuals and groups in different contexts;

5) Design, development and management of information systems and services - manual and machine-based;

6) Social, economic, political and legal features of information and information systems; and

7) Education and research in information generation, publishing, marketing and use.

These studies lead to further impact on information systems.

IMPACT OF INFORMATION SYSTEM DEVELOPMENTS

The impact of information system development can be classified as positive and negative as projected in Table 1.

Table 1

Impact of Information Systems Development

	Positive		Negative
1.	Higher quality information	1.	Increased information channels. Ex: 3-dimensional overloadgraphics
2.	Increase of "narrowcasting" with higher quality messages	2.	Increased manipulation of information sources,(transmission of sophisticated messages and channels and targeted in formation) in order to control theindividual
3.	Enhancement of interpersonal	3.	Frequent surveillance exchange, including improvement and loss of privacy of transmission capacity, through accumulated quality, economy of transmission records or live mediaand geographic range
4.	Increased equity of information	4.	Fragmentation of access useful special groupings, by isospecific needs of various information audien.
5.	Increased equity of information possession	5.	Inequitable distribution of information processing skills, as processing skills required to use high-level media escalate
6.	More flexible access and capacity to manipulate information	6.	Inequitable distribution of information
		7.	Inequitable access to information, through statute, conspiracy or purchasing power

INFORMATION RESOURCE MANAGEMENT

The balance between the positive and the negative aspects of information systems and their impact has to be controlled on the basis of information resource management. It is a process of efficiently and effectively identifying, acquiring, integrating, and applying information resource to meet the current and future information requirements. In particular, information resource management should aim at the following clusters:

1) Intellectual technology - that is, the capability to organise information and data of any type in any format for any purpose;

2) Information technology - that is, the knowledge of telecommunication, computing, printing and related hardware, including the ability to evaluate and cost the relevant equipment and systems;

3) Awareness of the potential role of information in varying environments, i.e. research and development, management, policy-making, decision-making, etc.;

4) Knowledge of managerial principles, i.e. personnel, accounting, financial, organisational behaviour, etc. and

5) Ability to communicate effectively both orally and in writing.

The main objectives of information resource management are to:

1) Reduce the information processing burden on the public and private sectors by the development and implementation of uniform and consistent information policies and practices,

2) Increase the availability and accuracy of current data and information,

3) Expand and strengthen information flow,

4) Establish focal points for information consolidation and transmission of relevant information to the end users and,

5) Facilitate quick and easy transfer of information to the target audience using multi-media data bases

Table 2.
Interactions among Various Disciplines

	Discipline	Connectivity with Information
1.	Mathematical Sciences	Formulating models, equations and statistical indices of growth, diffusion, transfer and organisation of information
2.	Physical Sciences	Developing analogous of movement and diffusion, structure, communicationand entropy in information field
3.	Biological Sciences	Developing analogous of growth and ageing of information phenomena;genetic epistemology, modes ofknowledge/discipline formation; neurophysiological and biocyberneticaspects of information processing and flow
4.	Linguistic Sciences	Expressing, structuring, coding, communicating ideas and informationidentification of roles of ideas inan expression.
5.	Behavioral Sciences	The study of human behaviour in the generation, search, acquisition anduse of information,
6.	Social Sciences	The study of the sociology of information production and distribution. The economics of socio-political, legal, cultural and management aspects of information availability and utilisation.

INFORMATION SCIENCE: ITS CONNECTION WITH OTHER DISCIPLINES

Knowledge organisation is the focus of information science. The issues of concern presented here call for interactions among a variety of disciplines as illustrated in Table 2.

Thus the wherewithal for rendering efficient and effective library service is a multi-disciplinary operation. However, all these fields of knowledge emphasise a user-oriented approach to information handling, because the only real value of information is in its use. The cohesion of the team in any cooperative endeavour lies in information flow from one to another. This information-flow covers:

1) A range of objects and events,
2) A distinctive memory-storage capacity,
3) A set of operations and transformations,
4) Specific principles that arrange formulation, and communication of information effectively.

Media change occur continuously. The development of technological media for storage and transmission of messages can be traced throughout the human civilisation. Speech was man's revolutionary medium from 10th to 100th millinia, writing a few millinia; printing for a few hundred years; and the recent electronic computing and processing for a few decades; micro-computing and telecommunication technologies within a decade.

PURPOSE-COMPLEX OF LIBRARY

It is obvious that knowledge holds the key to progress and survival of humanity. New knowledge is a prime requirement for researchers and industrialists if they are to contribute to economic progress; scientific and technical information, the medium for its transmission is the life-blood of this progress. Today, the need for such flows of information is no longer confined to science and technology; all decision-makers, whether in the public or private sector, want their options based on a wide assortment of data. For this purpose, research and development on information systems have tended towards improved access to scientific and technical documents by specialists in order to keep the communication system within scientific community in good health. Though this is important, it does not compare with seriousness of the day-to day problems faced by community leaders and individuals as non-specialists; and with which information systems could perhaps be expected to help. Much of knowledge and understanding they need or got is not scientific. All these factors suggest the value of library and information service in harnessing the flow of knowledge to variety of key persons, namely, policy-makers, planners, decision makers and achievers of target missions in economic, political, and social systems, besides the science and technology domain. For this purpose, free library service should organise itself to meet with five focal mission:

1) To provide a knowledge-base and work-situations for adults providing for their self-utilisation in professional, educational, and other spheres of their activities.

2) To provide for reading and media centres for young people for their self-education, learning and discussing their cognitive and behavioural needs, besides socio-economic needs.

3) To provide for people's university or distance education and open university programmes for educational and learning materials, planned in the central and distributive networks.

4) To provide for small adult material centre activities for the local communities tailor-made to meet their local interests.

5) To provide for informational and referral centre activities for the city and its communities located at the central library and supported by a central data bank.

A holistic approach in this regard was proposed by Ranganathan for the library service. This is what he said about a library:

"A library is a social institution. It is a multi-purpose social institution. Some of the many purposes in its complex are:

1) To serve as a social memory; for this purpose,

2) To assemble, organise, preserve, socialise and serve all expressed thoughts embodied as manuscripts, book, periodicals; these constituent documents, however minute, and every other similar document produced as a means for communication, and by this means,

3) To help in the transmission of knowledge of the earlier generations to the later one; and by this means,

4) To help in the cumulation and the further building up of knowledge from generation to generation; and in a similar way,

5) To help in contemporary development of knowledge without any wastage in the building of knowledge, by the unintended and purposeless repetition of effort and the consequent wastage in the research potential of humanity; and further,

6) To conserve the research time of humanity by the separation of literature search from positive research; and also,

7) To help in the perpetual self-education of one and all; and further,

8) To collect together all available recorded information, particularly in the form of reference books and to socialise and serve freely all such information to each according to his needs at the moment; and by all such means;

9) To increase the economic resources of humanity to the extent necessary to maintain the ever-increasing population, in comfort and free from want of any kind; and also,

10) To help in mutually understanding, mutually cooperating and mutually tolerant peaceful coexistence of individuals, communities, and nations, and further,

11) To help in the elevating, self-dependent, use of leisure with the aid of freely served books, pictures, sound records, and other similar materials; and also

12) To help in increasing the opportunity for the spiritual awakening of one and all of the members of the humanity. Ranganathan further delineated, "one personal help of a reference librarian, with an abundance of flair, is often necessary to make the library achieve its complex of purposes, social and individual: The true engineer of a library and information system is a librarian" [6].

Thus knowledge organisation is the base for achieving different purposes of a library system.▪

INFORMATION DISSEMINATION

Today' the information dissemination takes place in a variety of environments, between diverse people and through diverse media. The diverse people may be the invisible college, the communication link among peers, the interaction between scientists in the laboratory and those practising in the field - e.g. the technicians on the shop floor, the entrepreneur, the farmers, the health workers, the politicians' etc. - the intersectoral information flow; and transaction between these groups on the one hand and the common man busy coping with the daily chores and problems of life on the other. Besides the conventional media of documents and documentation services, the radio, the television, the audio and video cassette, and the satellite are becoming familiar objects even among the less sophisticated sections of society. Person-to-person dialogue, counselling, demonstration, exhibition, get-together, open-house, and a host of other methods are increasingly used for information exchange and technology transfer. Communication takes place from individual to individual, from individual to groups and from one group to another. Further, each medium and method of communication has its advantages and limitations and poses its special problems. In addition, societal characteristic; such as culture, language, political ideology, legal sanctions, and levels of development between communicator and communicatee can make or mar the information flow.

The tremendous potentialities of information technology resulting from the integration of communication technology and computer technology and its impact on business and industry, on government, education and health services, consumerism, political sociology, etc., are impressive and pervasive in all socio-economic activities.

While information explosion is prevalent all over, the needed information at any moment appears to be diverse and diffuse. It needs to be processed, that is, analysed, synthesized and tailor-made for easy assimilation. Thus, the capacity to handle and channel information to appropriate targets is important. The latter capacity is more valued one than mere abundance of information. Therefore, it is noteworthy that the capacity to handle information has become the means of access and source of power and potential for material wealth as a society tends towards technological and industrial growth. Knowledge organisation acts as a fabric for this growth.

STRUCTURE OF INFORMATION SYSTEM

Information systems have the following basic features in relation to the knowledge base.

1) They have a "control channel" and a "content channel", that is, knowledge-package.

2) They are "historical or current", that is time dimension of information and its conversion to knowledge.

3) They are "remote" or "local", that is, space dimension of information and knowledge.

The parameters of an information system are:
1) Its users;
2) Information sources; and
3) Technologies.

The users part calls for:
a) identifying the information needs, and
b) usage patterns and ease of use.

The information part calls for:
a) Information transfer mechanism (carrier media: paper, electronics or optical);
b) Information storage - memory;
c) Information retrieval techniques - classification/cataloguing/search;
d) Information resources - documents, institutions, human beings; and
e) Communication - mode and media.

Document Delivery Through:
Reprography including reprographics.

The technologies part includes:
a) Computer systems;
b) Telecommunication systems; and
c) Reprographics and micrographic equipment.

PROMOTIONAL ACTIVITIES FOR INFORMATION FLOW

The flow of information is an important factor for organizational management. This leads to the concept of information management. It is a process concerned with the design, development, monitoring and evaluation of cost effective systems to fulfil the objectives of a particular organization by providing an efficient flow of information to those who need it, when they need it and in a manner in which they need it. The information flow processes involve the following steps:

1. Information communication

- a) The interpersonal communication; and
- b) Telephone conversations.

2. Information product

- a) Document creation;
- b) Document storage and retrieval;
- c) Internal databases; and
- d) External databases.

3. Information analysis

- a) Research support systems;
- b) Decision support systems;
- c) Statistical analysis and operations research;
- d) Financial analysis; and
- e) Modelling and forecasting.

4. Information transfer

Document transmission and dissemination.

5. Activity management

- a) Schedule and calendar management;
- b) Directories - addresses and telephone numbers; and
- c) Tracking of items and information.

Following types of activities in R & D laboratories can be specified:

1. Project Task Information

Information related to the work to be done for a customer or a client; contact specifications; research proposals; schedules and deadlines, costs; resource availability, etc.

2. State-of-the-art Information

Information related to the general/specific scientific and technical capabilities.

3. Research Laboratory Technical Information

Information related to the success or feasibility of different kinds of research and laboratory techniques.

STATUS OF LIBRARY AND INFORMATION SERVICES

Compared to the information flow activities delineated so far, the library and information activities indicate a spectrum of information transfer services. The origin of libraries can be catapulted to the origin of recording of knowledge in the form of documents. The collection of documents become a library. The form in which the document is recorded has an impact on its organization. If it is in the form of a rare document, the library will strive to preserve it for a larger interest. Library acts as a conservator; for, a manuscript is the only record. If it is a printed book available in multicopies, the library would provide access to it and even lend it for regular use by its clientele. If it is in the computer-readable form, such as, magnetic tapes/disks, floppies, etc., it is made accessible through display media, such as television monitor and arranged for remote access. The spectrum of change from library to information centre, wherein documents of every form coexist, is also referred to as the thought-content of documents. The greater the volume and variety of information, the deeper would be the need for information processing, organisation and dissemination.

In this context, the library and information profession has to concern itself with broadening as well as widening the flow of information right from the generation of information to its use. It has the following implications in respect of human resources development in library and information science.

a) The form of library is changing significantly and rapidly. While new forms of documents are springing up the old ones remain to coexist with the new;

b) New types of library and information systems keep evolving; to quote Ranganathan "Library is a growing organism";

c) However, the basic needs of information seekers have not changed; they have tendencies to broaden their intensity and become multipronged;

d) Information itself is being generated in a variety of forms, and is often not oriented to specific needs and not very cohesive in its generation. It also tends to have a short half-life;

e) Therefore, it is necessary to improve the collection, organization, retrieval and dissemination of information. In general, access to information packages should be improved;

f) For the effective management of library and information resources, flexible tools and techniques many be adopted; in short there must be an amorphous information technology as a base.

The application of information technologies for operations and services in libraries has been increasing steadily over the last two decades. In addition, with the development of online databases, database vendors , such as ERIC, DIALOG, ESRIN, etc., librarians, specialists, even the Governments themselves, exhibit keenness for adopting modern information technologies.

All these aspects lead to the following conclusions:

1) Information technology, particularly relating to computer communication and micrographic technologies, has increasing impact on library and information services.

2) Storage, retrieval, dissemination and access of information are based on flexible devices.

3) Standards for interchange and exchange of information for customised services are being evolved.

4) The present type of techniques for processing and accessing of information may not be in vogue for long. Newer processing methods and access facilities are to be evolved, transferred and disseminated.

5) The library is going to provide costlier services on wider scale by adopting online storage, telecommunication and view technology.

6) The skills in manipulating and handling of information call for greater technological competence.

PROFESSIONAL SKILLS NEEDED FOR LIBRARY AND INFORMATION SERVICES

One should not consider that these changes have impact only at the post-graduate level; much of the impact would be felt even at the graduation and diploma levels. A live information profession, demanding more formal and operational skills than tool-oriented, is emerging.

In short, the impact of information technology has significant implications for the educational system in library and information services.

The library and information profession should inculcate knowledge and skill of a variety which is particularly useful in delivering the information to users.The features required for obtaining such a skill are as follows:

Professional competency analysis required for current day-to-day operations and future needs may be grrouped as follows:

A. Essential feeatures for most of the posts in library and information system

1) Knowledge of library philosophy;
2) Knowledge of library history and the socio-economic contexts;
3) Knowledge of general reference materials;
4) Knowledge of methods of organizing information;
5) Human relations skill;
6) Knowledge of general bibliography;
7) Managerial skills;
8) Statistical skills;
9) Knowledge of computer programming; and
10) Knowledge of foreign languages

B. Features important for positions of specialists in libraries:

1) Knowledge of specialized reference materials;

2) Specialized analytical skills and techniques;

3) Knowledge of collective development theories and practices;

4) Knowledge of library automation theories and practices;

5) On-line retrieval skills;

6) Supervisory skills;

7) Counselling skills;

8) Knowledge of policy-making aspects;

9) Knowledge of cost-effective and cost-efficient techniques;

10) Knowledge of document reproduction technologies;

11) Knowledge of binding; policies, methods and issues;

12) Knowledge of conservation methods for library materials;

13) Knowledge of information consolidation techniques; and

14) Knowledge of teaching and research skills

The professional trends indicate that a variety of professional competence is required in job market as follows:

1) The overall scope for jobs in library and information system, at present, appears to be bright. But there is scarcity of competent persons in spite of there being a large number of library schools.

2) Specialists in information handling and management are needed in increasing numbers in other than library environment, such as banks, industries, etc.

3) Few skills are necessary to adapt library and information techniques to non-library situations. But basic techniques of library science provide capabilities for use in other situations.

4) Industrial information environment also calls for professional managers. However, they should be very well acquainted with the technology, tools and methods of delivery of information, possibly in various repackaged formats.

5) The information industry itself calls for skills which are akin to those library and information comprising the skill of the technical presentation, the physical presentation, providing aid to readers and information users, formatting and indexing of information, etc.

In short all these activities hinges upon the skill for knowledge organisation which in turn depends on knowledge seeking, knowledge generation and knowledge use by a clientele. It calls for a framework flexible enough to meet the demands.

CONCLUSION

Towards this objective, Ranganathan devised his approach cohesively to meet the intellectual frames of individual. He did this through an analytico-synthetic approach, in which he combined elemental approach to a relational matrix and provided a multi dimensional object analysis. He further organised them in the context of a discipline or mission. He said "classification can illumine the field of knowledge. It can even be prophetic. To make it fit for this new type of foundation and built in a new way". Ranganathan thus believed in classification as a flexible intellectual tool for organisation. He felt that "it is only an analytico-synthetic scheme that can uncover thought content in such a holistic way" [2]. These form the basis for promotion of knowledge base and its utilisation by the end users. According to Ranganathan an analytico-synthetic classification is a search light. He said "the traveller will be helped much more, saved many wrong turns and attracted to the home more easily, if the light put up by the host is a search light which not only acts a beacon but also lights up the region through which he has to walk. Then will not merely the goal be glimmering but every inch of the way will be illuminated. The formula of facets and phase will serve the purpose of such a light to the classifier" [1]. Thus, . Ranganathan had defined the purpose of knowledge organisation to trigger light and knowledge in the minds of an inquirer or researcher, or classifier.

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RANGANATHAN AND THE ANNALS

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INTRODUCTION

Dr. S. R. Ranganathan's fifty years of outstanding service to the library movement and profession is universally acclaimed. He was the sole force behind the development of library movement in Madras and a guiding force in most of the states in India [1]. He played an equally notable role in the establistment of INSDOC in 1952 with the collaboration of UNESCO. To him, also went the distinction of being the founder editor of the "Annals of Library Science" (at present "Annals of Library Science and Documentation") from 1954 to 1963. which under his leadership acquired the status of the premier journal of the profession in India. Annals of Library Science was founded as a part of ABGILA (Annals and Bulletin of the Govt. of Indian Library Association). As its editor, Dr. Ranganathan provided the main inspiration and put in the maximum efforts for ensuring its growth to fulfill its mission.

Most of the original thinking of Dr. S. R. Ranganathan and his disciples has been reflected on the pages of the the Annals which has served as conduit to take the message forward and synergise collective thinking. A peep into the informative and educative articles contributed by him in the Annals would be quite revealing.

CONTRIBUTION OF RANGANATHAN TO ANNALS

Dr. Ranganathan wrote a number of books and articles relating to various aspects of library science and services thereby enriching the library literature.

George Aguayo in his paper (Spanish) had ranked Ranganathan's contribution to library science to that of Eintein to Physics. Dr. Eugene Garfield had also mentioned: "Ranganathan is to library science what Einstein is to Physics" [2]. A chronological presentation of total number of articles published in "Annals of Library Science" from 1954 to 1963 and the papers contributed by Dr. Ranganathan is given in Table 1 and fig. 1. Out of 176 articles published in "Annals"during the period 1954 to 1963, about 50% were written by him. To cap it all, he singly authored 74 articles and was the co-author in the remaining 13 articles. This clearly shows what a prolific writer he was and how dedicated he was to the work he had undertaken. Later, in 1970, he published a paper in "Annals of Library Science and Documentation.

Table 1.

Year	Volume No.	Total No. of articles published	S.R.R's contribution
1954	1	31	13
1955	2	19	10
1956	3	13	6
1957	4	17	9
1958	5	12	7
1959	6	17	8
1960	7	15	8
1961	8	14	9
1962	9	23	6
1963	10	15	11

Dr.Ranganathan's contribution in Annals
Vol. 1 - 10.

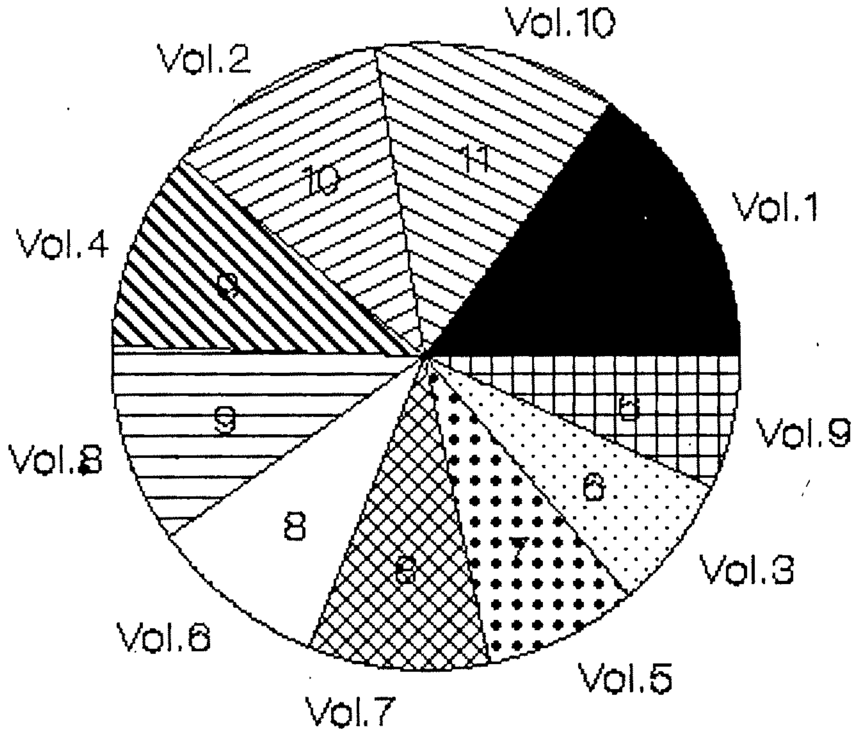

Table 2.
Subject-wise break-up of Dr. Ranganathan's articles during 1954-1963 in Annals.

Year	Vol. No.	Classification	Cataloguing	Teaching/ Training in Lib. Science	Documentation	Standards	Serials	Bibliography	Librarianship	Total
1954	1	7	2	3	-	-	-	-	1	13
1955	2	5	2	-	2	1	-	-	-	10
1956	3	3	-	-	1	-	-	-	2	6
1957	4	4	-	1	1	-	-	1	2	9
1958	5	4	-	1	1	-	-	-	1	7
1959	6	4	2	1	-	-	-	-	1	8
1960	7	3	1	-	2	1	1	-	-	8
1961	8	5	2	-	2	-	-	-	-	9
1962	9	1	1	2	1	-	-	-	1	6
1963	10	7	2	2	-	-	-	-	-	11
Total		43	12	10	10	2	1	1	8	87

A subject-wise analysis of Ranganathan's articles published in "Annals of Library Science" reveals (Table II) that he devoted much of his time and energy in writing about classification; that too on depth classification. He published 43, (50%) papers on this subject, 12 on cataloguing, 10 papers were devoted to teaching and training of library professionals, 10 on documentation and its various aspects. He also wrote about other aspects of library science, such as bibliography, stadrardisation, library building, library finance, serials, open access system, etc. Ranganathan's work in classification brought him world-wide acclaim and recognition and his Colon Classification has had a major impact on library classification. Faceted classification principles of Ranganathan have been used in arranging the entries in British National Bibliography when it was published in 1950 under the editorship of A.J. Wells. Many other National Bibliographies like Indian National Bibliography, Ceylon National Bibliography, etc., also followed the same pattern [3].

Ranganathan's article "Library classification glossary" (Annals of Library Science) 1958, [5] is one of his major contributions to library classification. Later on, an Indian Standard", IS.2550-1963: Glossary of Classification Terms" was formulated and published by updating and standardising this consolidated version of the glossary of terms in library classification.

Being a dedicated teacher himself, Dr. Ranganathan realised the fact that library profession was regarded in low esteem in the society. He worked hard to give it a status like any other profession by his writings on teaching and training of library professionals. Also, he founded the "Documentation Research and Training Centre" at Bangalore in 1962 which is still producing trained librarians/information scientists. It lead to the starting of a number of similiar courses in universities and institutions like INSDOC.

One of the cherished ideas of Dr. Ranganathan "Do one thing at a time, i.e. practice work chastity" [4] was crystal clear through his enormous contributions on classification in Annals.

A bibliography of Dr. Ranganathan's articles published in "Annals of Library Science" during the period 1954 to 1963 is given in the annexure.

CONCLUSION

It is evident from the papers published in the "Annals of Library Science" that Ranganathan's work and contribution are mainly in the field of classification although his contribution in cataloguing is also significant. The study also shows that he had also encompassed almost all the areas of librarianship.

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Annals of Library Science and Documentation 1992, 39(2), 69-71

RELEVANCE OF RANGANATHAN'S CONTRIBUTION IN THE AGE OF INFORMATION TECHNOLOGY

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INTRODUCTION

Two decades have passed since Indian library profession lost its father Dr. S.R. Ranganathan. In the year of his birth centenary, when the profession revisits its past, and the time of Ranganathan is recounted, an effective presence of his footsteps is clearly visible in the whole realm of librarianship. The first major landmark during his journey of the library profession that heralded on 4th January, 1924 when he joined as the librarian of the University of Madras, was the publication of 'Five Laws of Library Science' in 1931. It was followed by thousands of articles and some classics in the profession like 'Colon Classification', 'Prolegomena to Library Classification', 'Classified Catalogue Code', etc. During these five decades, which he spent in the service of library profession, Ranganathan was able to develop his philosophy as a living force. He was a torch-bearer in making library movement in India a successful reality. His role as a teacher, a librarian or a professional leader was always recognised and commended by the world professional community. Two decades after his passing away, the library world is stunned by the introduction of new information technologies, and the whole library scene looks so transformed that the traditional methods seem insufficient to cope up with the changed environment and the need is incrasingly felt to search for effective means to control the complexities arising in the library system.

A cursory look at Ranganathan's ideas and philosophy reveals some amazing concepts which have the potential to solve the complexities of the present system. Keeping in view his all pervading philosophy, the discussion here, is restricted to the relevance of some of his contributions in the context of computer and communication technology.

FIVE LAWS AND THEIR RELEVANCE

Dr. Rananathan made the first formal exposition of his five fundamental laws of library science in the presence of thousands of teachers at the Provincial Educational Conference in 1928 at the Minakshi College, Chidambaram, on the eve of its becoming the Annamalai University. Later on, these fundamental laws were published as 'The Five Laws of Library Science' in 1931 and the book was received by the professionals all over the world as a unique contribution. W.C. Berwick Sayers in his introduction to its first edition, states that "This is one of the most interesting books that I have read in recent years upon our profession. It is unique" [1]. The laws are so fundamental that they are still relevant in this age of 'information technology'. It is said that "a genius is one who foresees the future in the present", and rightly to this, the genius in Ranganathan enunciated laws that show his far-sightedness.

The first law - 'Books are for use', is so simple that it is accepted like the universal truth - 'the sun rises in the east'.

'Every reader his/her book'- his second law is really a preacher of democracy and speaks of the right of the reader to his information, which is, a much talked topic of today.

In the age of information technology, the last three laws are even more relevant.

The objective of the third law - 'Every book its reader", can be easily achieved today with the use of computers. In a manual system as Ranganathan suggested, the librarian has to adopt open access, prepare a comprehensive catalogue with all types of approaches, display books, etc. to achieve the objectives successfully. In the computerised environment, the gap between the reader and the book is bridged with the help of the indexes which are automatically built by the computer to facilitate search by maximum number of approaches.

The purpose of the fourth law - 'Save the time of the reader' is simultaneously achieved by the use of computers and computerised indexes. Use of computer reduces the time of information retrieval. Computers are now, used to provide quick access to information, whereas Ranganathan talked of this some sixty years ago.

F.W. Lancaster, while discussing the fifth law and its implications, says that, "Ranganathan was a futurist....he timely believed that the library profession will only survive and, retain its value if it continues to adopt to changes in its environment. This, of course is the entire thurst of the fifth law of library science; "Library is a growing organism" [2].

It is erroneously said that due to the impact of information technology IT, the fifth law has lost its *relevance*, as electronic publishing can save the space in the library. But it may noticed that multimedia and electronic publishing came on the fore front only after realizing the tremendous growth of literature. Ranganathan had sensed this development much earlier and stated that, "What further stages of evolution are in store for this growing organism - the library - we cannot anticipate fully who knows that a day may not come when the dissemination of knowledge, which is the vital function of libraries, will be realised even by means other than those of the printed books" [3].

INFORMATION ORGANISATION AND RETRIEVAL

Ranganathan devised some unique methods and techniques for information organisation and its easy retrieval. He coined a unique method to individualise every document in this world of information explosion through his Colon Classification (CC). Gopinath stated in one of his works "CC edition 7 aims at maintaining simplicity and brevity of notation relative to the complexity of ideas expressed in class numbers. It can be used as a base for the derivation of subject headings and thesaurus construction using a computer. Precision in the notational plane, via the use of indicator digits particularly, makes it easily adaptable to synthesis by computer in the formulation of class numbers", [4]. Moreover, Colon Classification is based on a sound dynamic theory, whreas other available schemes lack, more or less, a sound theory and are therefore, static. CC Ed. 7 is a freely faceted classification scheme. The concept of facet analysis has greatly enhanced its applicability. Commenting on the significance of the concept of facet in classification, Coates writes "probably there is no word introduced into the technical vocabulary of information science by Ranganathan which has been more readily understood and given acceptance than the word "facet" [5]. Facet analysis facilitates the formulation of search queries and users' query profiles for searching bibliographic databases. Ranganathan in as early as 1968 started a project called 'Doc-finder' [6] for fast document retreival, which was a pioneering effort towards the development of automatic classification.

Ranganathan propounded chain indexing procedure for retrieval of documents in a natural language order. He derived terms from the classificatory language, i.e., CC itself. At present in a database environment, retrieval is done through matching of keywords from the records of a specific database. Ranganathan's chain procedure also, gives a list of index terms that are used for searching.

BIBLIOGRAPHIC RECORD FORMATS

At present there are a number of bibliographic record formats such as US-MARC, UNIMARC, CCF, etc. These bibliographic formats promote free exchange of information from the records created in one format to another in machine readable from. Similarly, a Catalogue Code prescribes rules for output of the bibliographic records in a specific manner. However, it is not necessary to input data in the same prescribed sequence, rather it should be in such a manner that the output can be obtained in any desired form. For this purpose, the attributes of a document are to be identified. The 'Classified Catalogue Code' developed by Ranganathan, is one such code, "which prior to the development of database technology, identifies and specifies, in clear terms, all the possible attributes of the entity set - document (or all the discrete data elements of a bibliographic entity or entities) and makes them as a base for framing the rules for thier rendering, grouping as well as fixing their relative order or sequence within a bibliographical record for entry and display" [7]. Kashyap goes to the extent of saying that CCC is "one of the most suitable codes for identifying and defining data elements of a bibliographic entity, but also for generating computerised inputs and outputs of bibliographic databases" [8].

CONCLUSION

The ideas propounded by Ranganathan are seminal in nature and need a lot of attention from the professionals, academicians and researchers. Realising this, the Indian Library Associaitron and Sarada Ranganathan Endowment for Library Science organised an International Conference on Ranganathan's philosophy in New Delhi in 1985. A National endeavour to undertake research on Ranganathan's philosophy and ideas and to interpret them in the present day context may be intiated. This will be a great tribute to this all time great personality in the world of Library and Information Science.

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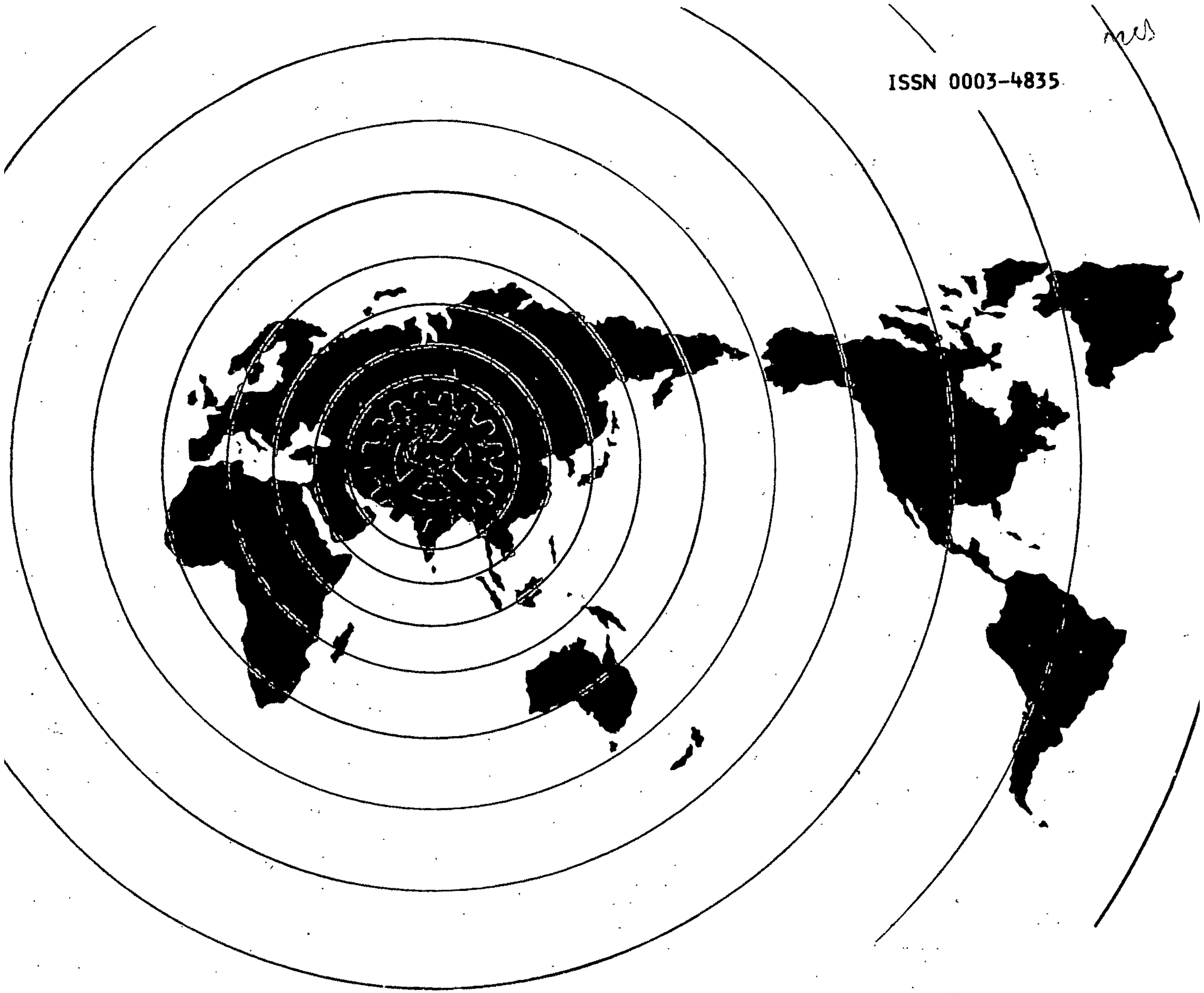

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THIS ISSUE IS DEVOTED TO THE THEME RELATED TO THAT OF THE IFLA 1992

Editorial

IFLA 1992

On 30 August 1992, the community of library and information scientists in India will be achieving an important landmark. The day marks the opening of the week long 58th General Conference of the International Federation of Library Associations and Institutions (IFLA) in New Delhi to coincide with the birth centerary celebrations of Dr. S. R. Ranganathan. It will be for the first time that IFLA which was founded in 1927 will be holding its important conference on the Indian soil.

IFLA is an independent international association having over 3000 members and affiliates in 132 countries. India is represented in IFLA through three national level associations, i.e. Indian Library Association (ILA), Indian Association of Special Libraries and Information Centres (IASLIC) and Association of Government Librarians and Information Scientists (AGLIS) and fifteen libraries and national institutions. INSDOC is an institutional member of IFLA. India also holds the post of Secretary of the Section on Regional Activities: Asia and Oceania, with three members in the Standing Committee. India has been associated with the activities of IFLA in one or the other form. During recent years India's role has gone further ahead by representation of second Vice-President from India in IFLA Executive Board.

The main objective of the Annual Conference of IFLA is to promote global understanding particularly in the fast growing field of information technology. The theme of the New Delhi Conference has been specifically chosen to focus attention on the library and information policy and perspectives. The theme is extremely relevant to the current trends in the country for application of new technologies particularly automation to the library and information activities. The conference will be instrumental in bringing a large number of internationally acclaimed authorities in the field of library and information science to India. Their counterpart professionals in India will have a unique opportunity of interacting with overseas specialists and benefit from their knowledge and perspectives. The visiting professionals will also get a first hand feel of the progress made by the library and information science in India over the years.

To mark the occasion, Indian National Scientific Documentation Centre has taken initiative to bring out September 1992 issue of Annals as a special number devoted to IFLA. It is hoped that the information projected through this number will help in creating greater awareness about the latest evolutionary trends in the field of information technology which forms one of the major objectives of India.

Annals of Library Science and Documentation 1992, 39(3), 74-80

OBJECT-ORIENTED DATABASE MANAGEMENT SYSTEMS- A NEW TOOL FOR INFORMATION CENTRES

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To improve service efficiency and stay competitive, information centres have to adopt continuously new techniques in system development, software and hardware which move the state of the art forward in information management. Object-oriented database management systems (OODBMS) are a recent development in the field of database systems. Their adoption and use will increase the capabilities and efficiency of an information centre. OODBMSs preserve the main features of classical database management systems and at the same time eliminate their disadvantages. Inadequacies of the present data models for new applications are highlighted, the features of OODBMSs are presented and the usefulness of an OODBMS is illustrated by modelling a typical application in an information centre.

INTRODUCTION

At present, the society may be said to be in an electronic era as there is a widespread usage of electronic products such as computers, TVs, videos, etc. even by common man. Information plays a vital role in day-to-day life. The information needs of the society have undergone changes in both qualitative and quantitative terms. As a result, serving the present generation of patrons calls for information centres to adopt new techniques in system development, software and hardware. Developments in hardware and software are taking place at a rapid pace. In order to derive maximum benefits from such developments, information systems must have a flexible design. The developments in hardware have led to the availability of powerful low cost systems. Software development has been witnessing the emergence of different software paradigms such as procedural, functional, logic and object-oriented. Different paradigms are suitable for different types of applications. Exploiting this, a number of efficient third party software packages have become available in the market supporting a variety of applications.

Database technology is vital to the functions of information centres. Present database applications in an information centre vary much from that of the past. For example, there is an increasing requirement to develop application systems that can manipulate multimedia data types such as images, voice and text, manage online database systems, handling high volumes of data and provide user friendly interfaces to casual end-users. Such applications require facilities for handling complex objects, incorporating semantics into databases, and supporting powerful and efficient trigger constraint and event mechanisms. Simultaneous with the rapid changes in hardware and software technologies, expert manpower to develop new applications is becoming scarce. Hence, the software environment must permit easy development of applications by novice professionals. Conventional database management systems are not able to meet these new requirements.

WHY CONVENTIONAL SYSTEMS ARE NOT ADEQUATE?

Relational database management systems, which are most popularly used these days, have been developed to overcome the deficiencies of the earlier network and hierarchical systems. Even the relational systems fail to meet the requirements of the advanced applications of an information centre. The relational model of data presents a tabular view of the world. It assumes that every entity has a fixed number of descriptive attributes and the values of these attributes may be presented in a tabular form. Unfortunately most of the real-life problems do not fit into the tabular form very well. For example, a document database containing actual documents can not be characterised by only a set of attributes giving the description and location of the documents. A document may be composed of pictures, graphs, text, etc. To handle such a database of documents, the system should support complex extensible objects. There are other applications which demand the support of dynamic objects. Here objects may change with time and their attributes may take different values at different

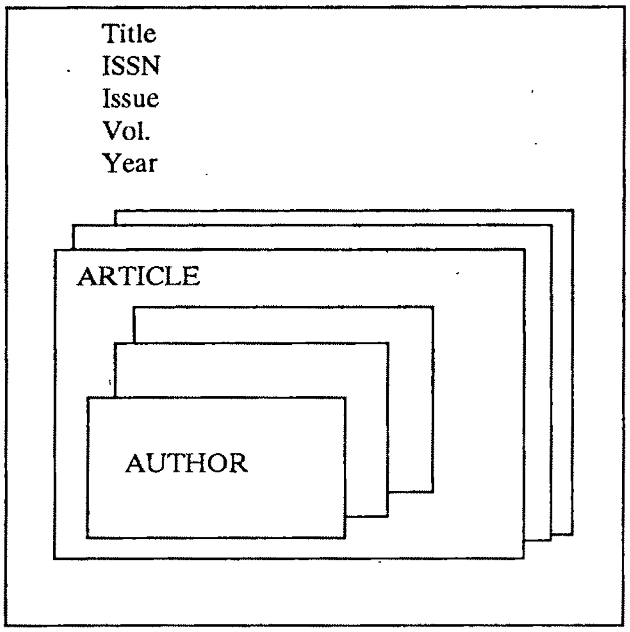

FIG. : 1(a) Journal

Journal-Id	Title	ISSN	Vol	Issue	Year

(Key-word : Journal-Id)

Journal-Id	Article-No	Article-Title	Page	Author

(Key-word : Journal-Id, Article-No)

FIG. : 1(b) Relational representation

points of time. Users may inquire about states of objects corresponding to different times. This may require some sort of version control. For example, in the case of serials in a library, titles of some of them may change with time. In conventional systems, it is difficult to keep track of such history of objects.

In relational systems, non-redundant representation of objects and dependencies call for normalisation which leads to multiple tables containing attributes of the objects represented. The relationships among these multiple tables are not visible in the database structure but are stored in application programs. There is no way for a user to find out the relationships from the database and he/she needs the help of the database designer or administrator for this purpose. Due to this drawback of relational systems, the semantics or meaning of real world situations cannot be incorporated into the database. Much of the knowledge of the database designer is not captured and preserved as part of the database. As a result, those who access the database later are rquired to possess additional knowledge to execute for example, meaningful adhoc queries. Moreover, partitioning a real-world object into different tables leads to inconsistency problems during the process of updation and deletion. When changes are incorporated in a table, the corresponding changes need to be reflected in the related tables as well. This may not be achieved correctly always in the absence of description of the relationships in the database. If the data model is able to support complex objects directly, these problems can be avoided to a great extent.

In the practical world of database applications the difference between the end-users view of objects and that of database structure of relations is a source of great frustration and difficulty. End users find relational and other conventional representation of objects quite cumbersome, overly complicated, and difficult to understand. For example, to represent a journal containing different articles (Fig.1(a)) in a relational system, one may have to decompose the attributes into different tables as shown in Fig. 1(b). End users want to deal with objects in a fashion that seems natural and convenient to them.

Relational systems do not support abstraction techniques such as generalisation and specialisation. For example, an entity of the type 'publication' which is a generalisation of items like books, journals, reports etc. may generally have an author and a title. But these two attributes alone do not fully characterise the entities. The general entity 'publication' needs to be specialised by different parameters for identifying the type of publication as shown in Fig. 2. For example, books do not have volume and issue numbers whereas journals do have. One has ISBN number whereas the other has ISSN number.

Object-oriented database management systems (OODBMS) is a post relational database management system which is capable of preserving the main advantages of classical database systems and eliminating their disadvantages.

OBJECT-ORIENTED DATABASE MANAGEMENT SYSTEMS (OODBMSs)

An object-oriented database management system can be defined as a database management system with an object-oriented data model. Object-oriented data model can be perceived, in a general sense, as a framework in which the real world semantics can be expressed with ease. Instead of set oriented records as in relational systems, OODBMS supports objects. The major advantage of an OODBMS is that any real-world entity can be represented as an object. For example, in the case of a serials system in a library, the entities concerned are journals, invoices, bank drafts, reports etc. All the entities are treated as objects. Objects may be as simple as numbers or strings or as complex as the complete details about a journal. In addition to the attributes of an entity the behavior characteristics are also clubbed to the object through procedures or methods (Fig. 3). Hence, in the case of an object-oriented system, objects contains both data and procedures. Object-orientation provides a natural way of representation of real world problems. Objects having the same characteristics and behavior are grouped into a class. For example, a particular book can be considered as an object belonging to a class say BOOK. In other words, an object is an instance of a class.

Object-oriented database management systems are the result of integration of object-oriented language features with database concepts (Fig.4). Language features include object-identity, inheritance, and encapsulation. Integrating these features with database concepts such as persistence, data sharing, integrity, query etc. results in OODBMS. Object identity is a feature by which one can distinguish objects from one another, regardless of their content, location or addressibility. In relational systems, records are identified using attribute values. But in

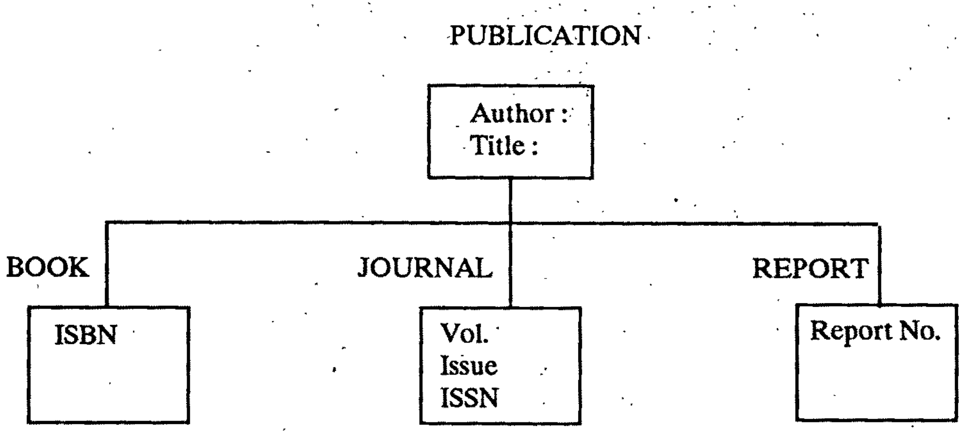

FIG : 2

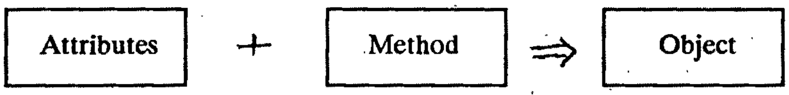

FIG : 3

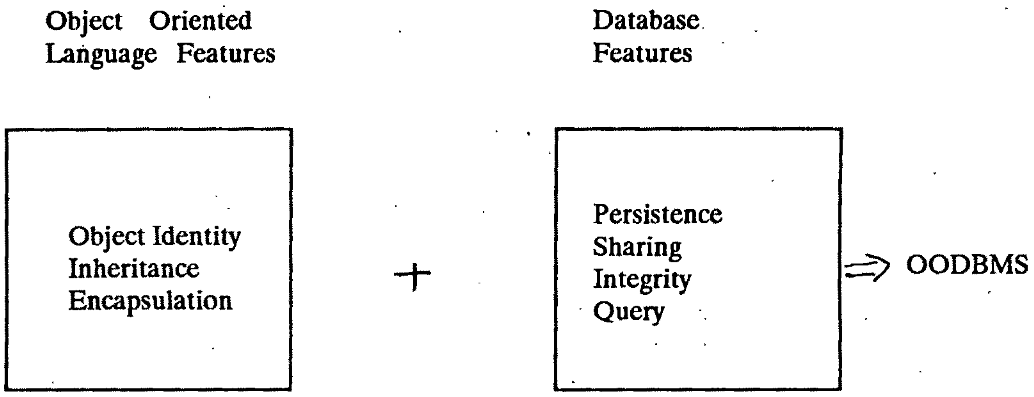

FIG. : 4

object-oriented systems each object is identified by a unique name, which can be either system defined or user defined. This is analogous to that of distinguishing objects naturally. Encapsulation is the formal term that describes the bundling of data and procedures or methods together. As an example, in the case of a desk top publishing system, documents can be considered as the objects. They have attributes like name, type and number. The procedures associated with the documents may be 'format', 'change font', etc. When we consider a document as an object, these attributes and corresponding procedures are clubbed together in it (Fig.5). This is called the encapsulation of data and methods. These methods act as visible interfaces to the object. So, an object is like an engineering black box which produces some outputs when some inputs are given. The internal processing is hidden from the outside world. In other words, the information concerning an object are hidden from the external world, but it is identified by the functions associated with that object. It assures that an object is independent of its implementation, and this ensures data abstraction and modularity.

As in the real world, objects in a system are independent of one another and they communicate among themselves by message passing. The paradigm of communication ensures that the objects are not directly manipulated by the users. Instead, a user sends messages to an object and the object itself determines the method by which it will react.

Inheritance is the mechanism for automatically sharing data among classes and subclasses. This mechanism is very powerful and is not found in conventional systems. Inheritance allows users to create new classes by programming only the differences from the parent class. Considering the desk top publishing system, a document can be textual or graphical. The characteristics of a textual and graphical documents are different. By inheritance, we can create new classes such as, text and graphics, from a parent class document (Fig. 6). The new classes contain all the characteristics and methods of the parent class and some additional characteristics and methods. Inheritance provides a means for reducing the effort required to develop and maintain a database. But its ability to allow a database to age gracefully is far more important. The key idea in inheritance is to provide a simple and powerful mechanism for defining new classes that inherit the structure and operations from an existing class. New methods and old structure may be overridden. Polymorphism is another feature by which different objects can respond differently to the same message.

These features facilitate a sophisticated way of dealing with data and hence provide advanced methods of managing information.

MODELLING A CIRCULATION SYSTEM

Consider a real world example of a book circulation system in a library. Two classes of objects exist: the BOOK and the BORROWER. Borrower gets a book issued from a library and returns it after perusal. Borrower is a person who has a registration in the library. So BORROWER can also be considered as a class which belongs to a more general class PERSON. Hence, we can consider BOOK and PERSON as two classes of representation. A particular book is an object which belongs to the class BOOK and a particular borrower is an object which belongs to the class PERSON. The appropriate data attributes for these classes may be

PERSON = (first name, middle name, last name, address, gender,..)

BOOK = (title, author, publisher, year, ...)
Also some of the functions associated with these classes may be get name, change name, get address, change address, etc. The attributes and associated functions together describe the class PERSON. So the class PERSON can be represented as

PERSON:
  DATA:
    first name,
    middle name,
    last name,
    address,
    gender, etc.

  METHODS:
    get name,
    change name,
    get address,
    change address, etc.

Thus the class PERSON has its own attributes and functions. A particular person or borrower is an instance of the class PERSON and is treated as an object having all the attributes and functions described in the class PERSON. The particular attributes of these objects will be accessible only through the functions specified with that object. For example, to change the name of a

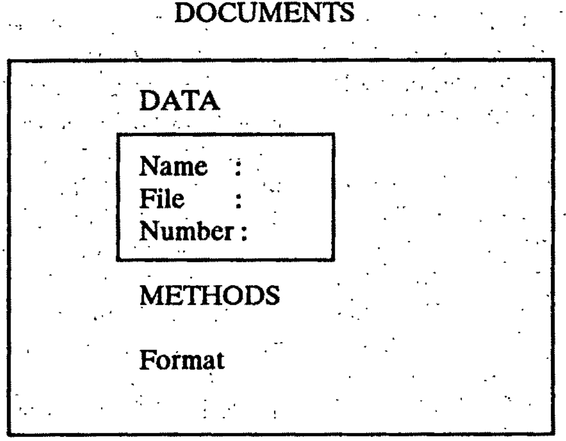

FIG : 5

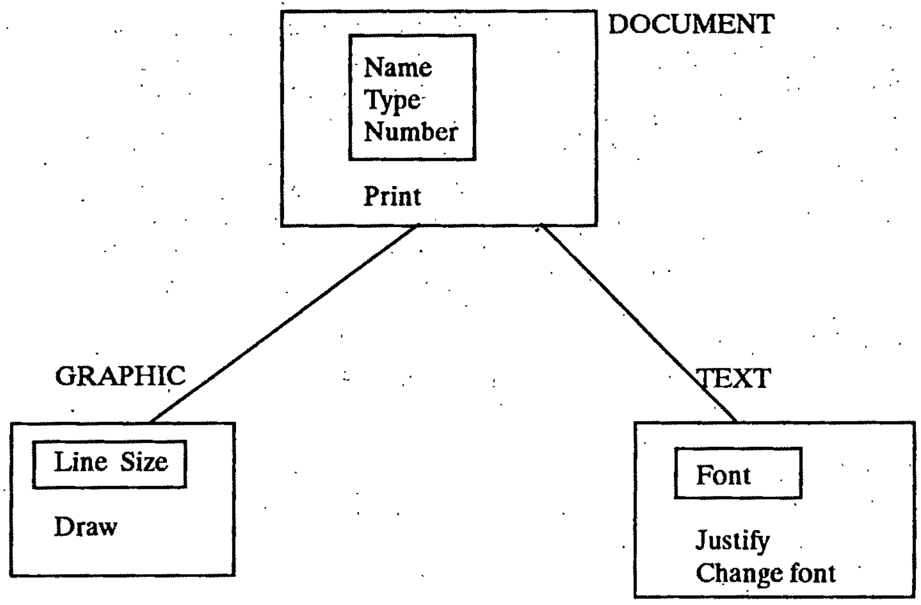

FIG. : 6

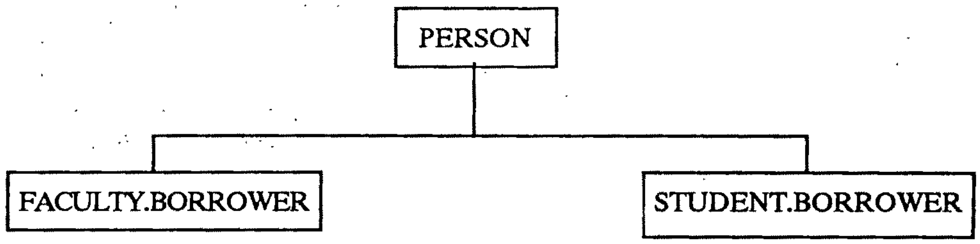

FIG. 7

particular person one should use the function 'change name' associated with the class PERSON. These functions act as visible interface to these objects and the attributes and are hidden from the outside world. Similarly, we can consider the class BOOK with its attributes and functions.

For a university library system, we can consider two categories of borrowers, one is faculty borrower and other is a student borrower. Therefore, we can consider two subclasses of the class PERSON, namely, FACULTY_BORROWER and STUDENT_BORROWER (Fig.7). By this hierarchical representation we have captured the idea that a FACULTY_BORROWER and STUDENT_ BORROWER have all the attributes such as name, address, etc. and functions, such as get name, get address, etc. specified in the class PERSON. These attributes and functions are inherited from the class PERSON. The subclasses FACULTY-BORROWER and STUDENT_BORROWER might contain some more attributes and functions, which are relevant to each of these subclasses. For example STUDENT_BORROWER might include attributes such as student_id, programme of study, batch no, etc. By this process, we have two specialized classes of class PERSON, viz. FACULTY_BORROWER and STUDENT_BORROWER. As far as class PERSON is concerned it is a generalisation of the classes STUDENT_BORROWER and FACULTY_BORROWER. There can also be subclasses of STUDENT_BORROWER such as, GRADUATE_STUDENT and RESEARCH_STUDENT, etc. The advantage of object-oriented approach is that, one can plug in any number of classes by inheriting characteristics of the existing classes at any point of the system development. This way of system design is tantamount to that of natural way of analysing real-life problems. By capturing naturally occuring objects of application domain into the classes along with the associated behavioural pattern, the object-oriented approach simplifies developmental process considerably.

CURRENT SCENARIO

A number of groups are working towards the development of OODBMS all over the world. There are about 30 OODBMS under development with commercial vendors, industrial research laboratories and universities. Most of these systems support the core object-oriented concepts and additional features with varying degrees of functionality. Some of the commecialy available systems are GemStone from Servio-Logic Development Corporation, Ontos from Ontologic, Inc. and Statice from Symbolics, Inc. Some of the industrial research prototypes are IRIS from Hewlett-Packard, O_2 from Altair, France, ZEITGEIST project at Texas Instruments, Jasmin project at Fujitsu, Japan, ORION from MCC Austin, Texas etc. Some of the university research prototypes are ENCORE/Observer project at Brown University, POSTGRESS at University of California and OZ+ at University of Toronto, AVANCE at University of Stockholm, Sweden, etc.

CONCLUSION

Information centres require very advanced tools to meet the present day requirements. They also need a system which is easy to use even by novice users. Object-oriented database management systems are very promising for database applications of an information centre. Since OODBMS permits incorporation of more semantics into its database, it is easy to develop applications. OODBMS are likely to replace conventional systems in the coming decade.

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KNOWLEDGE AS STOCK-IN-TRADE OF LIBRARIANS

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UNIVERSE OF KNOWLEDGE

French philosopher, Michel, Foucoult, published in 1980, his book, "Power/knowledge". In 1982, he published, "Is it really important to think"? Before and after these works, he had brought out a number of other important publications. Foucoult, was one of the pioneers of "Modernism" and "Post-Modernism" schools of thought. One of the most important concepts of his was about knowledge and power. This theme suits the libraries the most because knowledge is their stock-in-trade. Foucoult also emphasised, "Knowledge cannot be produced independently of its use".

Libraries are institutions which deal with utilisation of knowledge. Earlier, in 1973, Baniel Bell had published his classical work, 'The coming of post-industrial society', which heralded the dawn of the Information Society and gave the librarians and libraries an upward gradation. J.F. Lyotard came out in 1984 with his work, "The postmodern condition - A report on knowledge", which pleaded that it is only 'local knowledge', based on time and culture, that was being used largely, and emphasised that all forms of experience lived' must be incorporated to widen the use of this kind of 'local knowledge'.

The community of librarians has always viewed knowledge as global in character, synthesised in structure, and utilization as its sole objective. Bliss, Ranganathan, Shera, and others all have attempted this style and approach. H.E. Bliss wanted knowledge for social use, Ranganathan emphasised that 'knowledge' can lift the mankind to higher order, and Shera pleaded for 'putting knowledge to use'. While Shera was a contemporary of Foucoult, Daniel Bell, etc., both Bliss and Ranganathan were their predecessors.

KNOWLEDGE AND LIBRARIES

Ranganathan was the first in the world to prescribe a course on 'Universe of Knowledge' at the graduate level for librarians in order to give them an insight into the various aspects of knowledge. Librarians have always believed that librarianship is the management of knowledge from its generation, exchange to its utilisation (KGEU).

A group of scholars, from all over the world, has developed the concept of Knowledge - Generation, Exchange and Utilisation, (KGEU) and produced a comprehensive monograph under the same title. The group also publishes an international journal on the same subject. The latest book by Alvin Toffler, 'The power-shift' (1991), includes all information data, images and imagery, as well as attitudes, values and other symbolic products of society, etc., under the umbrella of knowledge. May be his intention was to escape the definitional quicksand. What Toffler pleaded in 1991 has been the librarian's endeavour for decades. Melvil Dewey, Bliss, Sayers, Ranganathan and others have emphasised similarly on this aspect. Ranganathan's works, 'Five Laws of Library Science' and 'Reference Service', on each page, deal with these facets of knowledge for their generation, exchange and utilisation through libraries and librarians. The concept of Knowledge revolution is accepted by librarians for the use and multiplication of knowledge by readers. Librarians have always been on the front line of KGEU activities and knowledge revolution. The author of every worthwhile book published today, acknowledges his thanks to a librarian for the assistance given by him. There cannot be a greater proof of a librarian putting the knowledge to use, exchange and further generation.

Librarians have always believed that if a society wants to progress and move towards growth, its first attempt should be to acquire information and knowledge. This is where libraries come into the picture and play a vital role. The librarians have succeeded in their mission. The task of libraries, to a challenging level, is also to moderate the impact of the unhealthy elements of the eternal-past on the life-style of people and to eradicate the outdated thoughts of unsound metaphysical nature from their minds. The libraries through dissemination of knowledge, have helped in viewing myths and superstition in a country in their proper perspective in the light of valid knowledge. The enlightened people have reviewed the age old concepts like eight hundered thousand cycles of life and death, untouchability, natural phenomenon surrounding people from birth to death, and the belief that the salvation of the individual is attained only after death, and certain other fossilised aspects of belief. Knowledge through libraries has helped the people in the growth of their personality without any attempt to commonalise the unique. The profession dealing with knowledge utilisation is bound to give due importance to such thoughts and movements.

Wherever libraries have not existed, the phenomenon of re-interpretation of concepts, from time to time, in the light of new knowledge, has failed to manifest. It is through self-education via libraries that a person inquired into uncongenial ideas practised by the man over centuries. In human thought, each generation, certainly in each century, experienced ever shifting frontiers of the "truth" and the "reasonable" and the libraries have helped an adult citizen to see such changes and modify his/her invalid older attitudes.

Majority of people are unable to refuse living totally in the past because they are illiterate and ignorant. It is necessary that the knowledge is made available to them to make them rediscover, re-interpret and synthesise their concepts and values. It is essential to harvest the gains of cumulative efforts of the whole humanity and help organise the crude heap of localised facts to extend their perceptions globally.

India's major problems are over population, stagnent economy and inefficient use of natural resources. The etiology behind all these problems is ignorance and non-use of the modern knowledge by the people due to absence of libraries and committed librarians. Even scholars, politicians and authorities have not been able to utilise the knowledge in these areas. In absence of proper utilisation of new knowledge perhaps doomsday is not very far off. In addition to educationists, the professional librarians-cum-informaticians have put the modern knowledge to use by the largest number of people through various libraries and other media, in various parts of the world.

MERELY ORAL COMMUNICATION

In the third world countries there are highly complicated (at times unproductive) life-styles, ideas, aspirations and values which continue to survive only on the word of mouth as the mode of communication. They do not incorporate new knowledge from time to time. In the last four to five hundred years the greatest gain of the mankind has been the development of social and scientific spirit (not at the cost of other spirits) and its intense cultivation over a wide area of human activity.

Within the third world the developments in social attitutes and scientific spirit have not been percolated to masses, because of lack of public libraries. These libraries, through extension services were bound to educate even the illiterates. The educated classes were made to limit their efforts to a classroom or a laboratory project because free public libraries were not there for lifelong learning. Therefore, unproductive values, myths and blind faith continued to rule the people.

The present age has witnessed the emergence of most profound scientific discoveries and social attitudes. Since these discoveries did not reach the masses through the medium of libraries, the faith and the interest of the masses continue in myths and ritualism. The third world societies have not yet taken new knowledge as the resource for mental development and as an equipment for effecting profound transformations in the context of new life. The minds have not been duly fashioned to properly receive the concepts of social welfare state and the technological civilisation in proper perspective because knowledge was not gathered in libraries for use.

Modern science and other social concepts have not become cultural modes to permeate the whole of society. Proper learning seldom takes place even in the educational system in absence of libraries. The reforms and transformations on the needed lines are not going to take place in the desired speed unless knowledge is put to use by libraries.

In the developed countries, for centuries, people have been learning through libraries all their lives. In the third world, in absences of public libraries, even a graduate relapses into a kind of practical illiteracy at the earliest opportunity. People, therefore, contiued living without information. For example, Flora and fauna, matter and energy, and substance, etc., have been around us for ages. What was not available with us was the proper information about them. So it is the information that is more important for the mankind.

"Information is more fundamental than matter or energy". It may appear to be idiosyncratic but it is very ture. What the mankind, including people in the third world, needs is the information. University graduates in these societies have to acquire information and in turn disseminate it to the masses. Librarians and informaticians have vital roles to play in this movement.

The quality of the third world life remains the same in absence of constant review of social and metaphysical thoughts and practices in the light of at least a generation's growth in the knowledge, which never reaches the people. The new knowledge acquired by the mankind over the centuries in many areas and contexts goes unnoticed by the masses of the third world because it is not disseminated to them. The masses cannot afford their own books. The lapse is due to the least use of books and other materials through the normal institution of libraries and information centres. The community of informaticians, to which the librarians belong, by virtue of their profession, has vital role to play in developing the information services through libraries in backward countries. Libraries are vital for developing a knowledge consuming and knowledge producing society. If the libraries are that important, the importance of the contribution of librarians cannot be underestimated. Ranganathan, and others lived under this faith.

KNOWLEDGE BROKERS

The phenomenon of multi-dimensional growth in knowledge has deprived the learner of his ability to deal directly with new knowledge. Now, it is not possible for a scholar to know at his own the total output of knowledge, say, in a year or two, in his specialised field of academic interest. One has to accept this statement. Even a noble laureate is dependent on an informatician for a comprehensive bibliography of literature in his field. Elbow support of a librarian is essential in generation and utilisation of knowledge.

It is very unfortunate that due to computerisation and closed access, a scholar cannot even directly see the collections of his interest in a documentation centre or a library. In numerous cases, the shelving of documents is no more in a filiatary subject-classified sequence. Materials have been organised on the basis accession number or some other criterion. Access to materials in such cases is not possible without the help of a reader's-adviser, a reference librarian or a documentalist, who, through conversation, identifies the exact requirement of the reader, pinpoints subject-headings and operates his computers or punched cards and then gives the list to the user. These trends reveal that a searcher of knowledge has to stand on the shoulders of an informatician, whatever be his/her exact designation, for using the knowledge in modern times.

The whole research activity of the world can come to standstill if, abstracts and indexes like, chemical abstracts, economic abstracts, humanities abstracts, etc., do not appear. It is the profession of informaticians which is behind the preparation of these vital secondary sources. Even tertiary sources have emerged as the output from librarians and are of vital use in initiating academic projects. The partnership between the scholar and the librarian is a phenomenon which shall become more thick in decades to come.

Thinkers of today have to conceive about 'Multiple - Transformative Capacity' on societal level, particularly in the third world. The aim is to work for allround resource mobilisation. For this, a Complex Processe of Social Learning and Communication with a Multiple Time-Space Perspective requires to be promoted. The 1970s and 1980s were witness to the emergence of global, planetary and international social movement, which provided the slogan 'Think globally and act locally'. Library as an agency, and librarianship as a profession, should be on the top of the list for developing multiple-transformative capacity on societal level, particularly for use of knowledge in the third world. India cannot ignore having pilot project of developing public libraries, in rural and urban areas, for dissemination and use of knowledge in a 'post-industrial information society' in which the country has already landed.

As honest brokers of knowledge and information, librarians have to deal with the great minds as generators and the masses as users. Apart from the specialised and technical knowledge required by specialists, general concepts, and information about them are required to be taken to all. A list of publications embodying seminal knowledge that should be taken to people in various forms (including oral form), particularly in the third world is given in Appendix A:

KNOWLEDGE AS POWER

Contemporary thinkers have pleaded for people's empowerment, for effecting social change and development. This can come exclusively through knowledge dissemination and use. The Western librarianship has been doing it for about fifteen decades in an effective manner. The famous description of developing 'selective rationalisation' by Habermas, 1982, depends largely on 'concentration of information' in libraries for lifting the masses. Consciously or unconsciously, the librarians have been doing nothing but concentrating, organising and disseminating information/knowledge for use. The law, 'knowledge/information is for use', shall always remain the guiding force.

Today, the concept of property has various forms. The most important form of 'property' is knowledge. A particular piece of knowledge can be a property to provide prosperity to many at the same time, while property of a particular piece of land or a bank balance can help only one specific owner. This feature of property is not properly appreciated both by capatalists and socialists in various countries. While fields and factories as forms of property, are exhaustable, the knowledge as a form of property is inexhaustable. Knowledge gets collected, organised, and disseminated from libraries. No body can afford doing these personally. Even the element of central planning essential for allround growth depends on KGEU factors.

Today, the top-down planners get more lies when they seek more data because of the poor quality of KGEU arrangements. Managers, bureaucrats, politicians, and even academicians operate without the requuired data/information/knowledge. It is only in the hands of libraries that KGEU services are of satisfactory standard.

The method for creating new wealth require enormous knowledge of various kinds, which cannot be obtained by the process of merely the centralised planning. Mere vertical flow of information/data/knowledge cannot sustain modern day planning and administration. Horizontal and diagonal facets of KGEU are highly important to make the planning and economics successful. The modern automated libraries, with alert and qualified personnel, can provide KGEU, of vertical, horizontal and diagonal type. The value of vertical, horizontal and diagonal species of KGEU lies, as it has been proved in this century, in converting the hardware machine into the machine with knowledge. "Chips" have provided this characteristic to machines. Success of chips depends on knowledge culture.

Mikhail Gorbachev surrendered in the rings in 1989, when he said, "we were nearly one of the last to realise that in the age of informattion science the most expensive asset is knowledge." [quoted by Alvin Toffler In Power Shift, N.Y., Bantam, 1990, p. 406]. The third world cannot ignore this phenomenon. KGEU becomes less expensive if selected libraries, in an organised manner, perform the tasks as national project of high importance. Globalisation of knowledge is going to take place because the mankind in the future, like in the past, has to live on some finer values. Homo sapiens cannot live like dogs, fighting constantly for ever. They have to share knowledge which has so far grown only through sharing. Libraries and Librarians have, therefore, clearly, demarcated their roles and responsibilities on their shoulders in times ahead.

APPENDIX A

Knowledge generated in the following works is to be disseminated by libraries and the librarians to masses

1.	Rachel Carson: Silent spring	(1962);
2.	Barry Commoner: Science and survival	(1966);
3.	The Club of Rome, report;	
4.	Meadows et al: The limits to growth	(1972);
5.	Dubos and Ward: Only one earth	(1972);
6.	Maddox: The doomsday syndrome	(1972);
7.	Goldsmith et al: A blueprint for survival	(1972);
8.	Foley: The energy question	(1970);
9.	Allaby: Inventing tomorrow	(1976);
10.	Allen: How to save the world	(1980);
11.	George: How the other half dies	(1976);
12.	P Harrison: Inside the third world	(1979);
13.	Brandt et al: North-South - A programme for survival	(1980);
14.	Heilbroner: An inquiry into the human prospect	(1975);
15.	Higgins: The seventh enemy	(1978);
16.	Schumacher: Small is beautiful	(1973);
17.	Dickson: Alternative technology	(1974);
18.	Cooley: Architect or bee?	(1980);
19.	David Collingridge: The Social control of technology	(1981);
20.	Colin Norman: The God that limps	(1981).

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TURN OF THE TIDE - A NEW AGE IN MULTIMEDIA PUBLISHING

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INTRODUCTION

There is dramatic growth in electronic information as a tradeable commodity. Recent figures suggest that the growth of electronic media markets is outstripping print-on-paper information. At this rate, global sales of electronic media will overtake the print media well before the end of the decade. To achieve this, the electronic publishers urgently need good, credible content and the traditional publishing industry as a potential supplier. The hardware companies are just as concerned because their future also depends crucially on the success of the new generation of electronic publishers who support their various platforms. After years of healthy scepticism, many traditional publishers are beginning to develop their own electronic publishing strategies. Major groups such as Bertelsmann, Hachette, Maxwell, International Thomson and Pearson are at last getting involved in what are often small, but serious ventures, particularly in the field of compact disc information media. A tide may be starting to turn in the history of publishing as even the traditionalists begin to redefine their mission. They are no longer confined to the book business: they are publishers of information, delivered in any form that makes good commercial sense.

ENTER MULTIMEDIA

Among many factors driving the electronic information industry forward there is one major development that looks certain to shape its future: multimedia.

It's the latest industry buzzword - but what does it mean? Views on exact definitions differ but the underlying idea is that a multimedia system is one that seamlessly integrates text, numerics, pictures, video, animations and sound within a single, digital information environment. This is a bit of a mouthful. It is probably easier to understand what multimedia is if we describe the story behind it and show how it is emerging as a vehicle for a new kind of publishing.

CD EVOLUTION

Philips has spent over a decade cultivating the huge success of its compact disc (CD) technology. Since compact disc audio appeared in 1982, over 50 million players have been sold and today CD music sales not only exceed vinyl disc sales, but are fast overtaking the massive sale of audio cassettes, too.

Philips was quick to see other potential in the technology, especially in its capacity to deliver not just music but all kinds of information. The key to CD's potential is that it is a digital medium. In other words, it talks the language of computers. This means information stored on CDs can be manipulated, processed and displayed by computer systems. Computerphobes may see this as more of a hindrance than a help and to some extent they have been proved right. Philips's first step in CD development was to create a medium it dubbed CD-ROM for 'read-only memory'. Now, instead of storing music on the CD, it was possible to cram on the equivalent of about three hundred thousand A4 size pages of text. Because the information could be manipulated by a computer, CD-ROM users could search such huge databases in seconds and extract information as needed. But a CD-ROM very visibly needs a computer. A special CD drive must be plugged into a desktop computer and, to get at the information, users need to be able to manipulate complex software. This means that CD-ROM is not an immediately friendly medium and growth in the market has accordingly been slow. However as increasingly useful databases become available, prices for drives fall, software becomes easier to use and 'techno-fear' begins to fade, CD-ROM markets are showing distinct signs of taking off.

ONE PICTURE IS WORTH A THOUSAND WORDS

CD-ROM has traditionally been mainly a text-only medium. Not because it was unable to store images and sound: CD-ROM is a digital medium so it can store anything that can be digitized. It has been best at handling text because it is only able to access and display one type of data at a time. if you wanted to combine text with sound and images and allow seamless access to them all, you would often find CD-ROM slow and cumbersome. It could first pull a picture off the disc, then add some accompanying sound and finally some text. But not simultaneously. Given this limitation, text databases turned out to be the most successful kind of application.

Philips's next step in developing CD's potential was dramatic, creating the concept of digital multimedia at a stroke. The company devised Compact Disc Interactive (CD-I), a highly evolved form of CD-ROM which could process and display different types of data simultaneously and display high-quality multilingual multimedia in a form designed to appeal the millions. From the outset, CD-I was conceived for the mass market. Its reliance on a computer was disguised by designing the CD-I player to look like a familiar CD audio player. Indeed, it not only looks like an audioplayer, it is one. In addition to CD-I discs, it can play music too, so tapping into the huge and mounting success of the CD music market.

By any standard, a CD-I player is an attractive-looking device that can be placed comfortably in a living room alongside the television, VCR and hi-fi. For play-back, all CD-I needs is a single connection to a domestic TV. The interactivity of the programmes is controlled by a simple infra-red handset which, when pointed at the TV screen, can be used to select different pathways through the multimedia information.

The only problem with CD-I has been its unavailability. Delay has followed delay as Philips and its Japanses CD-I partners, Sony and Matsushita, have struggled to perfect the technology. It was expected to see the US launch in October 1991 with European to follow in mid-1992. The price in the States is around $1000 and the European price is expected to be close to the dollar equivalent. This is an entry price, however, and is expected to fall rapidly.

MULTIMEDIA SPREADS ITS WINGS

Philips's CD-I is a brilliant first - a thoroughbred multimedia information platform that could transform the way we buy and use information in the home. There are also strong indications that the same low-cost, friendly system will find ready applications in professional and business markets.

Philips and its allies have not, however, managed to avoid competition. Commodore, the world's third-largest shipper of computers, has already lauched its own 'black box' multimedia system which it calls CDTV. It sells for less than 600 in the UK and looks in physical terms much like a CD-I player. The difference - and it is a big one - is that inside Commodore's black box is nothing more revolutionary than a CD-ROM drive and an Amiga computer. In other words, Commodore's CDTV is no exercise in innovation, just shrewd opportunism. Although CD-I is clearly superior, CDTV has the big advantage of actually passing the credit card test: you can walk into a shop right now and buy it. It is not just 'vapourware', a remarakable new product waiting hopefully in the wings. It is here today.

More widely, however, and CDTV apart, CD-ROM is now being turned into a genuinely multimedia vehicle through the steady development both of computer hardware in general and CD-ROM technology in particuular. Philips has established an enhanced version of CD-ROM that allows almost 'CD-I-like' access to multimedia. Meanwhile, a new world standard for *multimedia* computing has been announced by Microsoft. Supported by about a dozen of the world's top computer manufacturers (with the notable exceptions of Apple and IBM who have their own ideas about multimedia), the new standard will transform desktop computing by the late 1990s. Within five years, most personal computers will routinely have built-in CD-ROM drives plus the capacity for good quality video images and high-fidelity sound. Multimedia computing will become a global standard.

MULTIMEDIA AND THE PUBLISHER

What do these developments mean for traditional publishers? For some, they mean immediate new sources of income. Multimedia CD developers are hungry for two things: content and plausibility. Books with a proven track record of international sales not only offer an excellent source of content for multimedia productions but the respectability and recognition conferred by both a traditional, centuries-old medium and a product already well known in the market place. Major licensing deals now being struck are bringing some publishers rich new streams of subsidiary rights income. Among them, for example, Guinness Publishing has sold licenses to use its Guinness Book of Records and its unique trade mark in CD-ROM and CDTV productions; a CD-I licence is also under discussion. Random Century has made similar deals to launch CD-ROM and CDTV versions of the Hutchinson Encyclopedia.

A more strategic approach is also emerging among some other major publishers, particularly those who can count pictures as well as text among their assets. Maxwell Communications, for example, is making a major commitment to CD-I publishing by re-purposing some language-learning material, much of which is already available as linear video. Maxwell has formed a joint venture company with Philips called Maxwell Multimedia. Its first products were expected to be released before the end of 1991. Dorling Kindersley, a leading publisher of popular illustrated reference books, is beginning to capitalize on its huge store of nearly 200,000 photographs and pieces of artwork built up over years of book development work. Peter Kindersley recently sold a stake in the company (for a substanial sum) to Microsoft, which wants to utilize both the strong branding of some of DK's top-selling products together with their wealth of visual materials to create a range of multimedia CD-ROMs. DK, however is keen to keep its options open and is said to be considering its own multimedia programme across a range of CD platforms.

Many other publishers are taking stock of events. There is clear and growing awareness among print-on-paper houses that multimedia information products could soon generate lucrative new markets. The first CDTV and CD-I disc titles are already demonstrating that education, reference and information are going to play a dominant role in the mix of CD products. This is a territory publishers understand and can exploit. The tough trading climate facing most publishers today may counsel caution to some but to others it may suggest the need for an aggressive policy of diversification or, at the very least, an urgent need to utilize their copyright assets to the fullest possible extent through liceensing or in strategic alliances. The real money-making potential of multimedia is, of course, still largely untested. Only now are the first products coming to market. No one can be sure that anyone actually wants to buy multimedia until the first sales have been clocked up.

One thing, however, is sure. While the publishing industry has a lot to offer the fledgling multimedia industry, it may also have much to gain.

Courtesy "British Book News" October 1991.

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LIBRARIES IN 21st CENTURY IN INDIA

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INTRODUCTION

The meaning of the word 'Library' has changed considerably in recent times. At present this word is used for collection of books for reading purposes, libraries which can act as depositories as in the case of national libraries or a library system of a country, i.e., British Library, etc. Some of the libraries have emerged as Documentation Centres (not a very recent term) and others as Information Centres or Informatics Centres with the traditional Library as an integral part. The collection of libraries has also become diverse from stone tablets and palm leaves to printed books, audio-visual materials and computer readable files. The access of information of a library user has shifted from a collection at a location to databases located at thousands of miles away.

Library - whether public, national, academic or special - its main objectives and functions are to collect, organise and to disseminate the information to its users effectively and efficiently. Application of Information Technology in the organisation and services of libraries has brought a sea change in the functioning of libraries in the last two decades through out the world. In India the application of Information Technology (IT) in libraries is in its infancy.

As day by day the use of Information Technology is dominating the libraries, the librarian's skill in the application of this technology is becoming the deciding factor for the efficiency of services provided by a library. This is obvious from the point that the number of journals available in electronic media (CD-ROMs, floppies, etc.) are increasing day by day. The libraries are using computers, telecommunications, etc. for document delivery systems.

PRESENT STATE OF LIBRARIES IN INDIA

The tradition of libraries continue from ancient times in India. The ancient seats of learning like Nalanda, Vikramshila, etc. were having well developed libraries. During the medieval period the libraries flourished under royal patronage. The British Government had played a dominant role in setting up Calcutta Library which is now known as the National Library. After independence, with the establishment of several institutes of learning and a chain of R & D laboratories, the growth of libraries picked up a momentum. The country today has nearly 179 university libraries and 5500 college libraries. Apart from these, there are 1000 libraries attached to the scientific institutions and organisations, 550 social science libraries and 600 government department libraries. Added to these, there are archival and oriental libraries containing oriental manuscripts and a large number of documentation and information centres. In all, there are more than 60,000 libraries of all types in India [1].

Of the various library and information centres only few had started using IT for modernisation for their services and house keeping functions. As most of these are located in major cities of India, they could use the facilities available in these cities like modern telecom networks, computers, software houses, etc. These centres are far ahead of other libraries/information centres as far as resources (both financial and human) are concerned. Prominent among these are the information centres of national importance like INSDOC, DESIDOC, NASSDOC, etc., libraries attached to R & D Organisations and having sizable collection like the library of IARI, NDC of NIHFW, etc., the libraries of BARC, IISc, TIFR and the libraries of IITs and IIMs. Apart from these, some information/informatics centres are providing state-of-art information services. Some of these centres are discussed below:

INDIAN NATIONAL SCIENTIFIC DOCUMENTATION CENTRE (INSDOC)

INSDOC, setup in 1952 by the CSIR with the assistance of UNESCO to provide documentation services on a national scale has completed 40 years of its existence. During this period it had undergone 3 major phases of development.

During phase I (1952-1963) its activities included the services of document procurement, translation, reprography, printing and publications.

During phase II (1963-89), while continuing the earlier activities, a number of new activities like compilation of bibliographies, publication of ISA, compilation of NUCSSI and a number of other directories, and computerised information processing including the and SDI were undertaken.

During phase III (1989-) INSDOC has started the application of modern information technology in providing its services in a big way.

The current activities of INSDOC include creation of indigenous S & T databases, providing online database host services to the scientists in India, consultancy projects in the field of information handling, advanced training to information scientists and the bibliographic services based on online & CD-ROMs; the creation of SIRNET and the facility of E-Mail.

In the 8th Five Year Plan period the thrust areas of INSDOC would be:

1) Creation of 100 S & T databases of use to S & T community;

2) Setting up of a computer network of R & D organisations and providing online searching facility at 5 places;

3) Developing the trained manpower for handling S & T information.

INSDOC also proposes to strengthen R & D infrastructure to enable experimental work on networking, CD-ROM technology, electronic imaging, etc.[2].

INSDOC in collaboration with NISSAT is conducting several short term courses on the application of IT for library & information activities thereby leading the information community in India to the 21st century.

DESIDOC

Desidoc was established under the Defence Research and Development Organisation (DRDO) for providing information services to various agencies under the Ministry of Defence, Govt. of India. Desidoc provides a wide range of information services like document supply, translation, on-line and CD-ROM search, current awareness services, etc. Apart from these services it conducts short term courses from time to time for the application of IT for information activities.

BIO-INFORMATION CENTRE, JNU

To take full advantage of the Information Technology for biotechnology purposes, the Biotechnology Information Service (BTIS) was set up by the Department of Biotechnology, Govt. of India. The BTIS network constitutes about nine Bio-Informatics Centres (BICs) distributed all over India.

JNU houses one of the BICs specializing in genetic engineering. Which is providing the following functions:

Bulletin Board,
Database Search,
Current Awareness & SDI Services,
E mail,
Collection Development,
Development of specialised databases, etc.

Biotechnologists all over India are making use of the services provided by the nine BICs.

Efforts are being made to interlink libraries and information centres through computer communication technology in India because networking is one of the most effective ways of sharing the resources among libraries to meet the needs of information users. A number of information networks like INFLIBNET, CALIBNET, DELNET, SIRNET, BTNET, etc. are in the process of establishing by inter linking libraries and information centres in different regions and the university libraries, colleges, R & D institutions, etc.

INFLIBNET is a cooperative networking effort initiated by the University Grants Commission linking universities, colleges and documentation centres in India through the computer and communication technologies. National organisations like CSIR, ICAR, DRDO, ICMR, DOE etc. and academic institutions and universities will be participating in this network.

CALIBNET which is a Metropolitan Area Network (MAN), is supposed to cover 38 science and technology libraries in Calcutta Metropolitan Area.

DELNET once under operation offers sharing of resources in about 35 libraries in Delhi region.

SIRNET offer services like E-Mail, file transfer, document transfer, Information retrieval, etc.

I-NET, a network of the Department of Telecommunications, Government of India, besides providing access to international data networks through GPSS of VSNL, at Bombay offers facilities for interlinking terminals and computers located in important cities of the country through packet switching.

FUTURE OF THE LIBRARIES IN INDIA

It is indeed very difficult to forecast about the future of any institution, since future is not predictable or pre determined. Only the choices of individuals can influence the future outcome to some extent. To escape from this situation one may chart a number of alternative possible as well as probable futures. Consequently uncertainity comes to the forefront of planning. Scenarios provide a context for planning.

In order to forecast alternative futures for the libraries, Shuman [3] has chosen three principal areas from which elements for the expected scenarios can be selected:

1) Sociopolitical trends which affect the environment in which libraries find themselves;

2) Technological trends in which innovation and modern, automated systems and procedures have direct impact on the libraries;

3) Economic trends which concern themselves with the funds available within the environment and within the library so that it can carry out its mission and goals.

Some of the writers like Vannevar Bush, J.C.R. Licklider, Tom Childers, Marilyn Gell Mason etc. had expressed their views of what the library or information facility of the future might consist of. Bush [3a] visualised a new world of information storage and retrieval which would be convenient, rapid, and comprehensive with information needs of varied types of users considered. Today, with the availablity of IT tools like the micro-computers, the modem, the optical or laser disk, the high speed printer, the mouse, telephone connection, etc., what Bush envisioned as possible about five decades ago is not only a reality but has become common in developed countries and is becoming common in developing countries.

Shuman[4] portrayed nine quite different scenarios of future public library which can be categorised as Utopian, Dystopian and Incrementalist. They are:

Utopian

It is a stage where

> The library becomes fully automated and robotized, handling request for books, information, data, or answers in conversational mode.
>
> The library becomes a place where wonderous and exotic adventures may be experienced while relaxing in an easy chair with an electronic helmet on one's head.

Dystopian

This is a stage when

> The library disappears, unlamented and unmourned.
>
> Very little happens in the library as it becomes a vast, empty monument.
>
> Due to a nuclear explosion, a place very much like it was prior to the discovery of electricity.
>
> A place where the state controls not only the contents of the library but also access to those contents.

Incrementalist

This is a stage where

> A library is a place where only the poorer sectors of the community may enter free of charge. Others pay admission charges.
>
> A library becomes a place where only a certain type of information or a certain type of service is available.
>
> A library is replaced by home access to information and entertainment.

None of these scenarios are inevitable but all of them are plausible.

Information technology has its impact on the libraries and information centres in India though it was not very significant. Library networking, on-line services, E-Mail, etc. are already operational or in the process of becoming functional in major cities of India.

Compact disk has added a new dimension to the information business. The declining cost of CD-ROMs, its high storage capacity (600 M bytes), easy and fast replication capability, etc. are making optical disk a popular medium for publishing and data distribution. A glance at the data of CD-ROM market titles from 1987 to 1990 (1987-150, 1988-450, 1989-900, 1990-1500) [5] clearly indicates the increasing demand for this storage medium. The libraries are acquiring more of CD-ROM because :

1) It saves the shelf space and reduces the maintenance cost;

2) It is easy to handle and at the same time less expensive compared to other machine readable databases.

In-house use of the databases on compact discs is comparatively cheaper than providing on-line host service because it eliminates connect charges.

With the growing global awareness for afforestation and environmental protection, some of the industries like paper industry may have either to curtail their production or close down. This will make the paper a costlier product and consequently the publishers will have to look for some alternative media like CD-ROMs for publishing.

Since more and more publishers will be opting to bring out their publications on compact discs, the libraries in future will have no other option but to go for CD-ROM products. The huge, bulky volumes will be replaced by these small discs of size 4.75 inch diameter in future.

To sum up, the libraries of future will be having less of printed materials.

Already some libraries in India like NSL, DESIDOC Library, NAL Library, etc. are using CD-ROM products. In future more and more libraries will follow suit.

On-line access to databases enables the user to retrieve relevant and latest information in the disciplines of his/her interest with minimum time. There are more than 5000 international databases available through out the world pertaining to different subjects. These databases can be accessed for on-line bibliographic search through different host systems. INSDOC has established access to about 1000 international databases through DIALOG and EASYNET and provides information services to its clients [6]. Besides INSDOC, other institutions like NIT, New Delhi; CCMB, Hyderabad; Madurai Kamaraj University, Madurai, etc. have also established on-line access to DIALOG databases.

INSDOC has created a few on-line databases such as National Union Catalogue of Scientific Serials in India (NUCSSI), Polymer Science Database, Current Contents of Indian Journals, Material Science Bibliographic Database and Scientific and Technical Conference Proceedings (Union Catalogue, Bangalore). INSDOC is planning to create more databases in future.

Resource sharing among libraries will become indispensible in the future. The proliferation of publications, price escalation of library materials and financial constraints will necessitate the libraries to acquire only necessary and selected materials. In other words, libraries may not be in a position to purchase all the required publications comprehensively. Joint efforts among libraries, like networking, creation of databases of common use will be inevitable to render effective information service. Regional networks among the libraries like MALIBNET may be a common feature in the coming years.

CONCLUSION

It is clear from the present scenario that IT continues to dominate the information world. Electronic Communications will substitute other forms of communications to certain extent. Electronic Publishing will mostly replace print-on-paper publishing. Paperless communication systems will substantially be in vogue by the year 2000. The growing familiarity with new technologies among the users will affect the reading/ browsing habits of the users of the libraries in future. As a result of resource crunch, libraries in the 21st century in India have to pool their resources for sharing and procure the information sources which are cost-effective.

Sloat's [7] prediction about the information scenario in UK 2000 is true in Indian context too:

"Sophisticated systems will undoubtedly be centred to the development of the information industry in the 21st century, but only those systems will succeed which respons to the needs of the users and are perceived to be cost effective. Skilled, expert and understanding staff will be as important as the systems. In two decades we have moved from documentation to informations in two more, will we have moved from information to knowledge?"

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ROLE OF INFORMATION IN THE TWENTY FIRST CENTURY

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INTRODUCTION

Social commentators and observers of the changes in modern society are continually amazed by mounting evidence of an incrediable increase in the information that flows through society [1]. One of the most striking characteristic of a developing society is the sense of information consciousness that permeates throughout the populace of the society. They realise the importance of rapid and smooth access to the information for material and moral advancement. The rapid diffusion of electrical devices of radio, TV, computer is taken as the most impressive evidence alongwith cable TV, home video recorders and computer terminal of the information explosion which is a characteristic of 20th century. In this context reprography plays an important role in providing information to the society through its various processes. Every day, there is a huge proliferation of literature gushing out of the press continuously, which poses several problems for every library to organise and preserve the published literature. But the literature needs to be organised rather scientifically.

The published material containing the thoughts of saints, philosophers, poets, scientists and technologists is coming everyday in abundence. The contents of the printed literatures should be organized scientifically in order to make the best use of it. Reprography through microforms comes to solve the problems of storage. In this direction the contribution of electronic machines also can not be belittled.

INFORMATION EXPLOSION

This is an age of information explosion. The driving forces such as the remarkable progress made by science and technology during the last 150 years, the popularisation of political institutions through out the world and education in all section of the society, the introduction of speedy means of communications like telephone, radio, TV and supersonic jets etc., change in research pattern (i.e. parallel research, team research and relay research), the competition in trade and industry among various nations, Green Revolution in a developing country like India, the epoch making events like Bolshevic Revolution in 1917, the World war I and world war II, the advancement in printing technology and paper-making etc. were the sources and impetus for out pouring of information. The 'knowledge explosion' has obvious influence on the research activities in the country.

The information explosion that is taking place is staggering. Information explosion means the proliferation of ideas or creation of new information. To give a rough estimate about the number of documents generated in a year, there were approximately 6 million papers and articles published in the year 1980 alone in various branches of science and technology. Added to this is the famous law of Derak-de-Solla Price that the publications are doubled in every ten years. A situation can well be imagined during the 2000. AD, when there will be approximately 24 million of publications and if each paper runs for approximately 10 pages and for each such paper, 10 copies are maintained, there will be more than 2 billion sheets of paper for storage [2]. This huge production publications make information explosion a reality and some experts call it the 'Information Deluge'. It is, therefore, difficult for any agency to maintain most of the literature that is being produced from different parts of the world due to the limitations in funds, storage capacity and the methods of processing and retrieval of documents.

It may be mentioned here that by 2000 AD, in the countries like USA and Japan, the printed documents in libraries, particularly special libraries would be replaced by cassettes, magnetic tapes and other terms of non-print media and the homes and the offices of the users will be inter-linked with each other through computer terminals.

If the implications of 'information Explosion', are considered, it is seen that there is no 'explosion' in the process. The 'explosion' creates chaos and destruction. Information growth has not caused any chaos or distruction but has revolutionised the techniques of library science by the challenges posed by it. Hence it may not be incorrect to redesignate this phenomenon as 'information Revolution' or 'Second-Generation-Documentation' [3].

WHAT OF INFORMATION ?

Information is a message communicated by a communicator to a receiver. Information is also the product of human brain in action. It may be abstract or concrete. When a person begins to think, a variety of images and sensations flash through his mind which make some information to accumulate in the mind and his memory retains these pieces of knowledge. A close analysis of the variety of experiences gained by a person would reveal the relationship of these units with associated ideas. Different persons may derive a different set of experiences over the same units of thought and these experiences on identical units of thought remain isolated and less valuable if the individuals do not share their experiences [4]. The individual subjective knowledge of each person is transformed into objective knowledge by each individual's public expression via speech, writing, etc., or on being shared. Objective knowledge is publicly observable by all and comes very near to the concept of information [5].

CHARACTERISTIC OF INFORMATION

Information basically acts as a trigger to set a human being on an action plane. Information may be compared to kinetic energy which moves things while the recorded knowledge of a human being may be compared to potential energy which provides the reservoir. Obviously, all other things remaining equal (namely, resources, competence, opportunity, knowledge, etc.), it is the information that makes one human being more advance than his counterpart. Though information is a very important resource, it can be treated at par with other resources such as, men, machines, materials and money (the 4 Ms). The principal reasons for this are:

- information provokes oneupmanship;
- information is volatile;
- all information is not public;
- it is difficult to price information products and services;
- management of information is rather complex.

INFORMATION - AN INDISPENSABLE RESOURCE

For socio-economic development, information is an indispensable resource. The supply of correct and precise information in time helps the policy makers in making maximum use of the available resources as also in avoiding duplication of work. Similarly, a research and development programme can be accomplished successfully only if the required information becomes available as and when it is needed. Without proper and complete information, no worthwhile decision can be taken. In fact no progress is possible without the support of information [6].

Since the progress of every type is linked with the availability of right information at right time, access to it and its timely dissemination are of vital importance. There should be no barriers restricting this free flow of information.

INFORMATION RESOURCE

The information resources consist of

(a) documents, printed and non-printed, audiovisual, graphic, archival and the like;

(b) indexes, abstracts, state-of-the-art reports, numerical data, statistical surveys and tables, etc. and

(c) generated and processed data [7].

There has been tremendous revolution in the printing technology and at the same time non-print materials like microfilms, microfische, films, television, gramophone records, videotapes, cassettes etc. and these have been recognised as useful sources of storage and dissemination of the information.

Information is a vital corporate resource of which potential return on investment has not been achieved until now. Information is national intellectual resource - most valuable of all resources - since it can control physical resources of every kind. Both developed and developing nations recognise that scientific and technological information constitute most valuable instrument for economic and social development.

CURRENT TRENDS IN PRODUCTION OF INFORMATION SOURCES

Computers were first introduced to information sources in the early 1960's for the production of abstracting and indexing journals. Once in machine-readable form, files of bibliographic information were made available for searching, first in batch mode and eventually in interactive mode. Since then, the database services have been considerably enhanced to become the systems as known today [8].

Impressive as the application of computers and electronics to the primary literature is the state of the art of automated search through the secondary literature, the collection of citations, the abstracts and indexes that tell the searcher what information exists and where to find it. Without the help of the indexing and abstracting services the path of direct access to the primary literature in most of the professional fields would be impossible to traverse.

The abstracting and indexing services provided through MARC (Machine Readable Catalogue) project at Lockheed is one of the major commercial information retrieval systems in the United States.. The machine search epitomizes the current offerings of high technology to the information world.

IMPACT OF TECHNOLOGY

Since Gutenberg first printed from movable type, technology has been the handmaiden of those institutions devoted to the printed word. Today electronics and communications have so extended the range of words and thoughts, in print and in audio-visual forms, that the very word 'information' has become an abstraction whose roots and bounds no one fully comprehends [9].

The impact of technology includes the introduction of

a) Computer
b) Micrographics
c) Telecommunications
d) Audio-visual media

Computer

Outstanding among others, the computer technology has received widespread attention in the last decade. The effective computer based information systems are not only limited to transformation, storage and retrieval functions but also include the mechanism for control of various other components of the information system.

At present the computer device is at the core of both the information revolution and the post-industrial society. Computer acting like a fast giant brain has significant and potential impact on data handling, acquisition, processing, storage, retrieval and dissemination, and their consequent role in aiding decision making, planning, problem solving, etc. and in development - catalysing activities in government, business, industry, research and other sectors. Alongwith the above usefulness, the decreasing cost and the increasing power of the device make it more popular and the main driving force in the new 'information age .

Micrographics

Primary to the success of business is productivity. In highly competitive world of today, time means more than money. Inefficient information flow costs a company more than just losing man hours. It increases operating costs, decreases production, and lessens the profit opportunities. 'Micrographics' can help in systematically organising the information flow in a business environment and to find the information when ever one wants it.

The paper explosion has created the greatest problem in the information society of today. The 20th century produced a large number of information and data and most of it is on paper. Information need to be compiled, evaluated, retrieved and disseminated for effective use. Magazines, books, product catalogues, trade literature, inventory, customer billing, production and maintenance records, etc. make up for this huge mass .of information. Banks, insurance companies, hospitals, personnel and accounts departments, manufacturing firms, R & D organizations, drawing office, libraries and information centres are the places where this problem of 'Information Management' - is alarming. It is high time that some solution was found to tackle this problem of 'Information Management' in a scientific manner. The 'micrographic system' plays an important role in preserving the valuable records at the minimum space.

Micrographic technology has been improving steadily over the past decade and the systems can now interface with computers to store and generate information on demand automatically. Today, microforms are used to provide secure, compact, reducible, accessible and economical records management systems. Microfilm offers tangible solutions to any business which must maintain records economically and retrieve them very fast. The micrographic technology is here and it's shaping the way we handle information today and tomorrow [10].

Telecommunications

Telecommunications has grown out of all recognition during the first half of 20th century and has entered very deeply into the lives of the people particularly through the telephone and broadcasting services [11]. Telecommunications cover all types of communication, including television data, teletypewriter, and facsimile.

With the increased concentration of population in large metropolitan regions, more efficient means are being sought to provide the data requirements envisioned in the future. One result could be that with a computer terminal shopping, banking, and other services are carried out at home in a routine. Widespread use of cable TV would provide an alternate, wide-band communications system in each home, parallel with the telephone system. All kinds of data and picture services could be provided via such a system. All the activities, professional, social, shopping, business and educational could be conducted from inside the home. Public service communications of various types - fire, police, education, health, transportation - are commonly carried out separately in urban areas [12].

Audio-Visual Media

This type of communication includes illustrations, charts, pictures, maps, slides, film strips, video-tapes, and a variety of microforms. The audio-visual materials could be effectively deployed alongwith the oral communication in order to enhance the effectiveness of the communications. The audio-visual not only provides the required information but also it gives fun and entertainment.

The commendable developments in the fields of computer and telecommunication technology including satellite communication, photo-composition, printing and micrographics, have the major impact on huge mass of information resources [13].

Newspaper libraries which till recent times were facing the problem of storage of a huge number of newspapers, are now able to store them on compact reels. The papers of the whole year can be recorded on only five to six reels and can be made available to the reader through the microfilm reader.

According to Lancaster, in the year 2000 AD, "every scientist will have an on-line terminal in his office. Perhaps he will also have one in his home. The terminal will likely to have some form of video display to receive information and some form of key-board to transmit information. The video display might consist of a CRT device, a plasma panel, or some other display mechanism yet to be invented. The key-board may be only one of several communication devices available with the terminal. Some form of communication may be achieved by light pen, by finger touch, or other mechanism". In addition, a portable terminal may be available to be carried home and around when travelling. Portable one would be a lightweight typewriter device. The scientist will use his terminal in a routine manner to input, transmit and receive information. Perhaps this may not be true for India in a very near future.However, we might reach this stage a little later.

The keynote address delivered by Dr. Daniel Bell in Boston meeting published under the title "Welcome to post-industrial Society" has emphasised the impact of technology on information science on three different stages upto the present time, i.e. pre-industrial stage, industrial stage and the post-industrial stage of society.

In the pre-industrial stage as defined by Dr. Bell, the information was based on the natural sources obtained by the human being directly from the nature. These resources were exploited by mankind for day-to day use by manual labour, power of wind and water.

In the Industrial Society this was replaced by machine oriented technology by means of gas, electricity, etc.

Finally, considering the post-Industrial Society as 'Information Society', the results were properly utilised by the people in all spheres of their life [14]. It will also be possible to make available the contents of the books in a number of libraries on computer readable media. A compact disc can store as many as 50 books or as much data as 11000 floppidiscs can accomodates. The application of fibre technology to the present system of communication will revolutionise telecommunication system.

Conferences and conventions may be organised on television which does not require the physical presence of the delegates at one place. They may be talking to each other as if sitting in a single room even though they are at a distance of thousands of miles. All these are the pointers towards a paperless society.

EMERGENCE OF INFORMATION TECHNOLOGY AND MICROGRAPHICS

The information revolution of today is indisputably caused by the unprecedented advances in information technology comprising computers, telecommunications, micrographics, and reprographics. The advancement in technology has made the accessibility to world information and knowledge possible from any part of the globe.

Until the advent of automation, the most significant previous technological innovation in libraries was the introduction of photo-copiers. Ralph Parker installed, in 1936, a punched card system for circulation control at the University of Texas [17]. The application of automation achieve the economic goal of increasing productivity rather than use of computers to effect economies. Since early 1960, in USA, computer application for library operation has been considered for processing information which resulted in achieving more information production. The introduction of third generation and fourth generation computer systems, increased speed and memory size along with a shift unit record concepts to files stored on disk for 'on-line' acess. Thus the results of computer processing became available to people using the system in a matter of seconds rather than in hours or days.

Realizing the need to access information available at any corner of the world and to face the challenges posed by the 'information age' in the 21st century, most of the institutions in India are also getting themselves equipped with the modern technology.

In India, the facsimile transmission is there through which information can be communicated over the telephone wire employing arrowband facsimile technique. Facsimile transreceivers were also developed under Technology Development Council Project (TDCP) in 1981 [18]. On 16th March 1984, the Post and Telegraph Department in India has come out with an indigenous system on the lines of teletext which will provide a variety of information from film programmes, reviews, music information about theater, food prices, farm prices, recipes, science news, financial news, special information on education, etc.

New methods of information storage and retrieval are discovered. The conventional books and news papers are being replaced by microfilms and microfiches. Albeit it has not become very popular in developing countries like India, It has made quite a headway in the west. One may be surprised to know that compared to paper, microfilms and microfiches are cheaper and easier to handle and distribute. The greatest benefit of course is saving of space. The microforms come to rescue in this matter as the microforms take 70 to 90% less space than books. Thus microfilms take up only small space. It is estimated that a library of 60,000 volumes can be easily stored in a single drawer of a filing cabinet. Due to the growth in literature, we will be coerced to store the thought contents of these documents in microforms. It would not be exaggeration to say that microfilms are forerunner of paperless publishing in near future. There is every possibility that at the end of 20th century the libraries may become almost paperless (if not fully).

Thousands of years ago, people recognised the necessity of keeping records of their daily activities. The carving of paintings and graphic figures on the walls of caves evolved, over the centuries, into a more complex form of languages and written alphabets. Paper was invented and the art of writing and record keeping came to be defined. As more and more records on paper developed, complex storage methods were devised to house these records. But they took more and more room, and finally, people began to run out of space. Something was needed to be done, and in 1800s an English photographer, John Benjamin Dancer, experimented and developed the process of microphotography, which is today known as 'micrographic'. In the 1800s, a Frenchman, Rene Dagron, realised the possibilities of this new process for record keeping and is credited with being the first to use micrographics on a commercial scale [19].

Micrography is an important branch of reprography. According to Gerrysts "during the siege of Paris in the France-Prussian War of 1870, microreproduction had been used to put messsages into microforms which could be conveyed out of the besieged city by carrier-pigeon" [20]. But the regular use of microphotography as an aid to documentation started in 1906 [21]. The computer output of microfilm is greatly influencing the information system. This technique of photochromics enables the record of information in a grainless way. Holography and laser recording are also beginning to play a great role in micrographics. The rapid growth of microforms is due to the serious space problem created in the libraries by information deluge.. Certain technological developments in the field of micrographs have led to the library scientists to control all the situations. Although no serious effort has been made to provide a professional forum to establish closer liasion between the users and dealers of micrographics systems, still during the last few years, the evolution of micrographics and its applications has been quite significant in India. With the objective of encouraging the use of micrographic technology in this country, the Micrographic Congress of India (MCI) was founded on 20th February 1982. MCI aims at developing closer links between manufacturers/suppliers of micrographic equipment and systems in this country [22]. In this regard, it may be mentioned that Resource Centre on the micrographics should be built in India comprising informative literature to improve the information flow among the members of MCI.

CURRENT SCENE (Paperless Society)

In this age of science, electronic computers provide information which subsequently helps to reduce the bulk of the printed material. Thus, the computers also have significant contribution in making the libraries and the society paperless in future. The developing countries have also reached a stage where technology particularly the communication technology threatens the very existence of traditional libraries. In a forecast of telecommunications in the 2000 AD. Martino visualises that "rather than visiting a library any individual might be able to search the library files electronically and receive a printout of specific information or a facsimile copy of a desired document". They are heading towards a paperless society as stated in recent article by Allen Kent. At the first sight, one may think that the introduction of computer system will make the services of the library personnel completely redundant. But this is not the case; because, technically qualified personnel will be essential to provide access to databases and data banks. These technically qualified personnel are essential to work in the exploitation of the resources of libraries. So far as the situation of the libraries in the electronic world is concerned, the libraries still have the important role to play to collect, catalogue and index materials of local interest. It seems likely that librarians and other types of information personnel will have a vital role to perform in a paperless system. The information personnel who are familiar with the resources available in machine-readable form and with vocabularies, query languages, indexing techniques and search strategies will still be needed to exploit these resources most efficiently and effectively. In the electronic world, the libraries still may have a role to play in giving training to the scientists and others in the use of machine-readable resources. In fact, training would become a major activity of the librarian by 2000 AD. The BBC announcement of recent past visualised that the house computers would be sold by the well known broadcasting organization as seen by computer experts and this again leads to the emerging of a paperless society. Further, it is seen that such a society would be ushered in with computer selling as cheap as TV sets. Infact computer has started replacing all documentation work including letter writing, cheque writing, etc. Electronic mail is another development which is rapidly getting popular with the Indian scientists. It is estimated that as much as 60% of the postal mail could be eliminated if electronic mail was introduced.

WIRE CITY

The Hi-Ovis TV system in cooperation in Columbus in the USA is nearest to the future 'wire city' concept of the 21st century where most people need only to remain at home and yet perform many productive functions and shop at the super market or order any service or select any programme they want to see on the TV screen. Two-way TV integrated with telecommunications would provide data access of the magnitude now beyond imagination. This would make telecommunication an integral part of life.

Even the future news-paper would be fed on this 'wire system' working with one more wonder invention: 'the fibre-optics' [23]. Prof. P. N. Kaula has opined that it would be more correct to term the future as 'Balance Media Society' but not 'Paperless' [24].

CONCLUSION

21st century will be the age of creativity. The paperless society is round the corner, whether we like it or not. There is sure indication that the conventional paper-based documents would vanish from everyday life. The substitutes for paper, viz. The microforms, are not popular yet, because of the inconvenience one has to suffer while using a microform reader. With the advent of pocket-held video units, one would, hopefully, be more comfortable. The Japanese have already introduced wrist-watch TVs and therefore, a paperless situation is not far way. Now it is the time for various responsible organizations to study its various technical implications in order to meet the challenges of the paperless society towards the end of 20th century.

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Courtesy "Proceedings of the Seminar on Management of Information Industry in Twenty first Century held at the TISCO Technical Institute, Jamshedpur during 16-17 April, 1990."

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A PLAN FOR COOPERATION AND NETWORKING AMONG ENGINEERING AND TECHNOLOGICAL LIBRARIES IN INDIA

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INTRODUCTION

Librarians of today are facing two major problems. They are a) information explosion and, b) price escalation of library materials.

The production of publications in various fields, especially in the field of science and technology is rapidly increasing. It is estimated that the primary source literature of science and technology was becoming double in every fifteen years and now it doubles in ten years and thus this doubling time is rapidly coming down.

According to the UNESCO statistics of world book production, about three lakhs of books are published every year. The number of learned periodicals in the field of science and technology has now increased to 60,000 adding at the rate of 1,000 periodicals annually.

Thus, this vast publication of literature is posing a problem to the librarians to take a decision about what to acquire and hold in their individual collection.

Another major problem the librarians are facing is the price escalation. Publication costs have been increasing rapidly because of the rising costs of labour, materials and facilities. The price of all the publications, especially the subscription rate of current periodicals is increasing every year. It is surprising to note that, in the year 1940, the annual subscription of the Chemical Abstracts was only $12 and today it is $12,000.

Thus, it is virtually not possible for any library, however big and rich it may be, to acquire all the publications that are required for a comprehensive coverage.

In order to find a solution to these problems, the concept of cooperation has emerged among the libraries.

THE CONCEPT OF COOPERATION

In simple words 'library cooperation' is a combined effort of two or more libraries to share their resources and functions, to provide better facilities and services to their users and decide ways and means of reducing cost in the library functions.

The engineering and technological libraries are academic in nature, and these libraries aim at equipping themselves with the materials that are needed for the undergraduate and postgraduate students, research scholars and the faculty members of the institution.

The engineering and technological libraries can be grouped mainly into three types:

a) Five IIT libraries situated at Bombay, Delhi, Kanpur, Kharagpur and Madras.

b) Fifteen REC Libraries situated in different states

c) 142 Engineering college libraries.

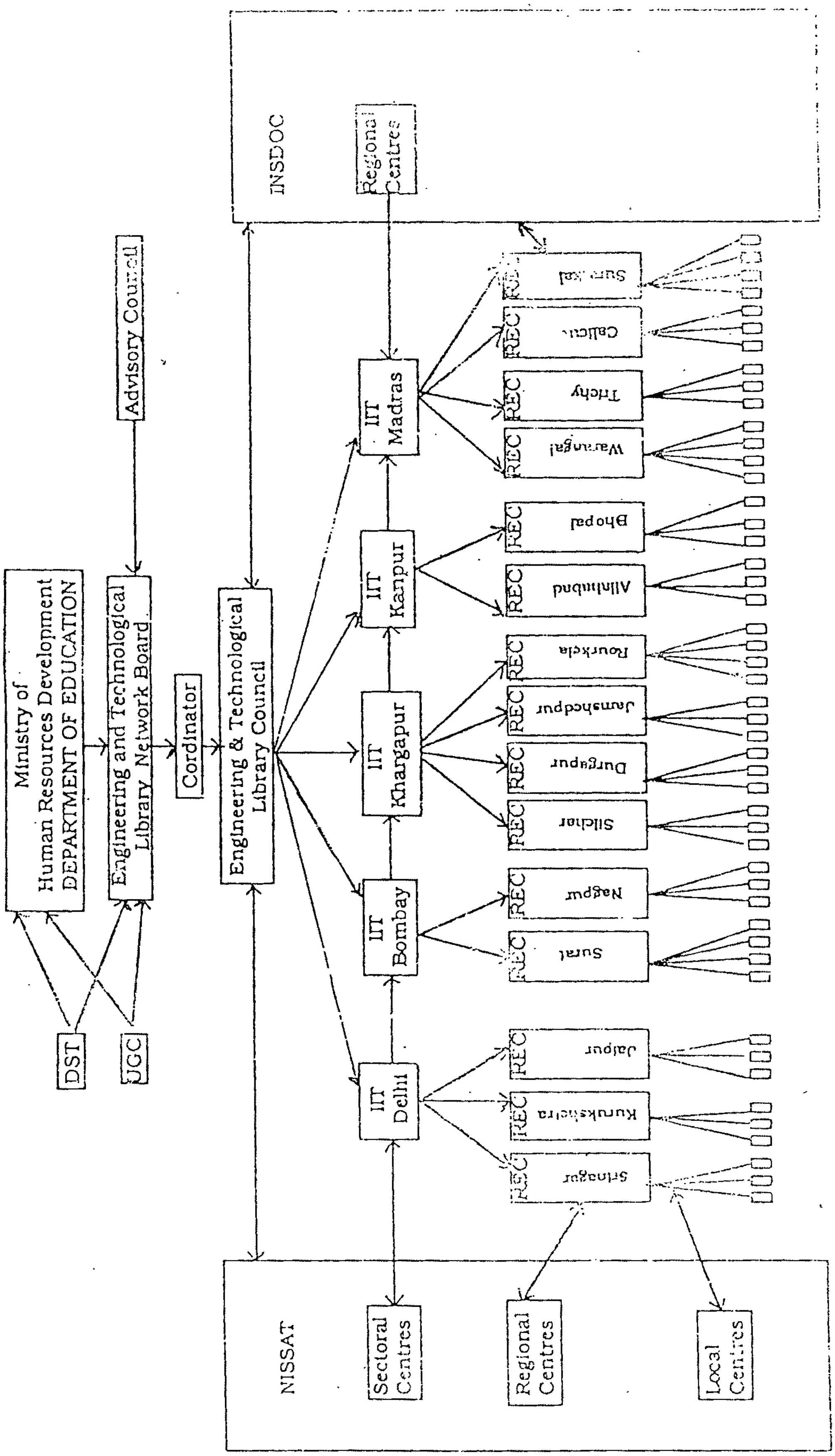
NEED FOR COOPERATION AMONG INDIAN ENGINEERING AND TECHNOLOGICAL LIBRARIES

Cooperative network for sharing resources among engineering and technological libraries has become a necessity for the following reasons:

1) The difficulty in acquiring the full range of library resources.

2) Insufficient financial support for acquiring library resources.

3) Steady increase in the cost of library materials.



ORGANIZATIONAL CHART

4) The missing information or the information gap caused by what a librarian desires for a basic library collection and what he can acquire with the limited funds.

5) Increased emphasis on avoidance of national wastage due to unnecessary dupli cation of engineering and technological sources.

OBJECTIVES OF THE STUDY

1) To evaluate the existing resources available in the engineering and technological libraries.

2) To make an assessment of the present staff working in the libraries, especially in acquisition and technical processing sections.

3) To study the existing cooperative services provided by these libraries.

4) To appraise the attitudes and the opinions of the librarians on the concept of network ing of the libraries of engineering and technological educational institutions in India.

5) To find out the major obstacles in the effective implementation of the cooperative networking among the engineering and technological libraries.

6) Finally, to design and recommend a cooperative networking among the engineering and technological libraries for optimum utilization of resources.

METHODOLOGY

The study is based on the survey method using questionnaire, interview and review of literature techniques.

A questionnaire was designed to get information on the current status of the engineering and technological libraries, their present cooperative activities, and the attitudes of the librarians towards the proposed library network activities, and also the problems of cooperation.

An interview technique was also employed to supplement the data gathered through questionnaires.

Besides using the questionnaire and the interview for gathering the data, the relevant literature was also reviewed.

The questionnaire was sent to all the 162 engineering and technological libraries. Out of which 87 i.e. 53.7% responded. The data is analysed and presented briefly as follows.

MAJOR FINDINGS

1) Results of the evaluation of engineering and technological libraries show that about 55% of total book stock, 61% of total current periodicals, and 90% of total bound periodicals are available only with the high group of libraries. The average collection of these materials per library is also more in high group libraries in comparison with other groups of libraries.

2) The collection of thesis, reports, patents, specifications, photocopies, translations and non-print materials which are essential for research activities are also available with high group of libraries.

3) It is observed that low group of libraries are facing the problem of shortage of staff. Moreover their professional manpower is being wasted on routine functions, such as acquisition, classification, etc.

4) Forty five engineering and technological libraries have sixty two photocoping machines. The number of machines per library range between one to five.

5) A majority of engineering and technological libraries have a uniform acquisition policy. Out of the total personnel available in these libraries, 13.4% are working in the acquisition activity to procure more or less the same type of documents.

6) Majority of engineering and technological libraries follow common classification and cataloguing practice. Out of the total library personnel, 8.3% of library staff are working in technical processing sections processing the common documents.

7) No formal cooperative activity exists among engineering and technological libraries. The activities such as, interlibrary loan and exchange of the lists of new additions to the library are maintained informally. Librarians expressed that there is no formal agreement or policy for inter library loan.

8) While assessing the opinions of the librarians about the twenty one proposed cooperative activities, almost all the librarians expressed that these activities are highly desirable.

Table 1
Link between Engineering and Technological Libraries in different states/ Union Territories with Zonal Operating Centres.

	Zone		State/Union Territories
1.	North Zone IIT, Delhi	:	J&K, Punjab, Rajasthan, Delhi, Himachal Pradesh, Haryana, Chandigarh
2.	Central Zone, IIT, Kanpur	:	Uttar Pradesh, Madhya Pradesh
3.	East Zone, IIT, Kharagpur	:	Bihar, Orissa, West Bengal, Assam, Manipur Tripura, Nagaland, Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, Andaman and Nicobar
4.	South Zone, IIT, Madras	:	Andhra Pradesh, Karnataka, Kerala, Tamilnadu, Pondicherry and Lakshadeep
5.	West Zone, IIT, Bombay	:	Maharashtra, Gujarat, Goa, Daman and Diu.

9) The responding librarians opined that the problems of lack of library cooperative policy, lack of planning, lack of human resources, lack of financial support and lack of spirit of cooperation are crucial and necessarily must be overcome.

PROPOSED COOPERATIVE NETWORK

Based on these findings a cooperative network is proposed:

Network Structure:

The proposed network structure for engineering and technological libraries would be both centralised and decentralised. Each IIT library would function as a Zonal Operating Centre (ZOC). All the engineering colleges in that zone would be the members of the ZOC.

The geographically distributed engineering and technological libraries in different states and Union Territories would be linked in the network of five zones with each IIT as its Zonal Operating Centre as shown in Table 1.

The network would function at three levels as shown below:

First Level

All the five IIT libraries would act as Zonal Operating Centres. These centres would be supported by NISSAT and INSDOC for their development. They would interact with each other and be linked with sectoral centres of NISSAT and regional centres of INSDOC.

Second Level

All the regional engineering college libraries would act as Sectoral Operating Centres. They will also be linked with regional centres of NISSAT and INSDOC.

Third Level

All other engineering college libraries would act as Local Centres. These centres would directly avail the services of the Sectoral Operating Centres.

ORGANIZATIONAL STRUCTURE

It is proposed that engineering and technological library network might be established under the Ministry of Human Resources Development, in the Department of Education. Members from zonal and sectoral operating centres, UGC, DST, NISSAT and INSDOC might represent the Board of Directors of the engineering and technological library network. A coordinator might be appointed to serve as the chief administration and planning officer. One of the directors might be elected as the chairman of the board.

Various working committees might be setup for planning and presenting proposals for cooperative action in the specific areas.

The Advisory Council would be established to advice and assist the Board of Directors. The members of the council might include the directors of IIT's, principals of REC's, directors of INSDOC and NISSAT, chairman of UGC and DST. This group might meet annually with the board to review the progress of network and give further suggestions (Fig. 1).

CONCLUSION

Although the proposed plan is only a theoretical one, it is hoped that the plan will give directions to Indian engineering and technological librarians for the establishment of a cooperative library network. it will also be a base for the development of national library network in India.

Courtesy "Proceedings of the Seminar on Management of Information Industry in 21st Century" held at Jamshedpur during 16-17, April 1990.

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INFORMATION MANAGEMENT IN 21ST CENTURY - NEW TRENDS AND TECHNOLOGY

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Twentyfirst century is expected to change the entire scenario of information science. It will then be possible to communicate information in voluminous amounts with the help of information technology over long distances in seconds. The present information age is going to face much more challenges due to rapid technological advancements which will create new wave of opportunities for using information in virtually all human pursuits. All developments are to be watched critically and closely "for information itself is power" and the power of information takes on even greater dimensions in the information society. Information technology does not consist of only the hardware and software but also the management techniques used to handle and process information, their application, etc. The rapid advancements in the field of information technology has resulted into communication revolution giving rise to new social condition which is being described as Information Society'.

INFORMATION SOCIETY

The credit to develop the concept of information society goes to Japan where the term 'Johoka Shakai' or 'informationalised society' was coined around 1966 by a science, technology and economics study group formed by the Japanese Government. They described information society as one in which there is abundance of quality and quantity of information with all the necessary facilities for its distribution. The information should be easily assembled, quickly and efficiently distributed and converted in the form suitable to the user. Other common rubrics to 'information society' include 'age of cybernetics' (used widely in 1960s) 'electronic age' and 'age of information' (both proposed by Marshall McLuhn in 1954) 'knowledge society' described by Peter Drucker in 1969 and 'electronic society' suggested by Zbigniew Brezezinski in 1970, 'electronic age' etc. The information society has its main thrust in information management, the acquisition, processing, provision and instantaneous dissemination of information.

In order to clearly understand the dimensions of an information society it will be desirable to have a look at the criteria for the development of information society. Martin [1] has identified these criteria which are given the Table 1.

Thus in an information society the key factor is information and its development depends largely on the application of information technology to exploit the information to meet the needs and satisfaction of the end - users. Today concerted efforts are being made by various agencies in this direction to develop information products and services with a suitable provision of their speedy communication through a wide range of medias mostly electronic medias and its effective and efficient management.

THE INFORMATION EXPLOSION

A plethora of knowledge is being unfolded every day. This situation of overwhelming mass of available information is being denoted by 'information explosion', 'information deluge', 'information crisis' and even 'information revolution'. It is a common knowledge that during the present generation more science related information has been produced than in the past. This is because of the ever increasing specialization and diversification of knowledge, need of distinguishing oneself in academic circles and increasing number of printed or recorded information in various forms.

Today the amount of information available in books, articles, in periodicals, abstracting and indexing periodicals, conference proceedings, seminar papers, bibliographic data-bases has grown phenomenally . According to a rough estimate, S &T information now increases 13% per year which is likely to jump to perhaps 40% per year. Therefore, information in this field will double every twelve months [2]. Electronic data bases and data banks have proliferated. It is estimated that more than 4000 on-line data-bases are available today containing, at a conservative estimate, over 100 millon records and growing at a rate of 8 million records per annum.

Thus the overwhelming mass of available information and its ever increasing characteristics create really difficult problem for searching or locating information pin-pointedly and expeditiously. The quality of information rarely improves with the quantity. So the problem further gets complicated. The availability and accessibility of masses of information on any imaginable subject is going to exert tremendous pressure on library and information centres to either move with the technology or stagnate. The information explosion situation, therefore, seems to offer three options for today's information workers, i.e. to exploit, to ignore or to be overwhelmed by it. A worldwide information and intelligent network is not far away as the beginning has already been made in this direction with the application of computer and communication technologies.

INFORMATION TECHNOLOGY: AN OVERVIEW

Currently 'information technology' is the latest buzz word in the information arena. In fact the ways of communicating available information from various sources to end-users are among the major challenges of present times. Today information cannot only be stored, retrieved and disseminated in enormous quantities but also at phenomenal speeds. Information technology offers an unprecedented opportunity for storage, retrieval, manipulation and exploitation of the information. Basically "information technology" connotes an ensemble of technologies i.e., the trinity of computer, telecommunication and microelectronics. There are three key components of the new technology. These are:

a) New ways to store information compactly and cheaply;

b) New mechanism to manipulate, scan and search such records; and

c) New facilities for cheap and rapid transmission of information over long distances.

The important features which affect the quality of information are accuracy, comprehensiveness, freshness and time. Advances in information technology which are being utilised for library and information activities are as follows:

a) Computer-hardware and software
b) Storage technologies
c) Data-bases
d) Telecommunications
e) Information systems
f) Microforms and micrographics
g) Expert systems
h) Videotex and teletext
i) Electronic mail

Computer Technology

Computer technology has undergone tremendous change both in its hardware and processing capabilities which in computer terminology are known as First Generation, Second Generation, Third Generation and Fourth Generation Computers. Currently using the recent advances in the field of artificial intelligence, American and Japanese computer manufacturers are competing with each other in developing a 'thinking computer' which could be called as the Fifth Generation Computer.

Currently available computers are classified as personal microcomputers, super microcomputers, large computers and super computers. Computers are already used for library operations and information services. The arrival of microcomputers has revolutionalised information management bringing in speed, effectiveness, efficiency that were previously unthinkable. The available microcomputers are classified into three types, viz IBM-PC, IBM-PC XT (extended technology); ·IBM-PC/AT (advanced technology). The latest addition to the family of microcomputer is the 32 bit 'super micro' having a memory expandable upto one gigabyte offering a processing speed of 2 MIPS and supports large disks and a variety of I/O devices.

The impact of computers has permeated all sectors of librarianship and information retrieval. In India, a good number of library and information centres have started using computers for acquisition, classification and cataloguing systems, indexing and thesauri, circulation system, stock taking, periodicals control system, CAS (current awareness service), SDI (selective dissemination of information), retrospective search, etc.

Software

The hardware of computer determines its capacity for storing and processing information. The software comprises an hierarchy of programmes which intervenes between the users and the hardware.Presently, software is becoming even more important than the computer itself.

Software is usually categorised as system

Table 1

Criteria for the Development of an Information Society

Technological Criteria:	Information Technology (IT) as the key enabling force. Widespread diffusion of IT in offices, factories, education and at home.
Social Criteria:	Information as an enhancer of the quality of life, widespread information consciousness and end - user access to high quality information.
Economic Criteria:	Information as a key economic factor as resource, service, commodity, a source added value and employment.
Political Criteria:	Freedom of information leading to a political process characterised by increased participation and consensus.
Cultural Criteria:	Recognition of the cultural value of the information through the promotion of the information values in the interest of national and individual development.

Table 2

Software Packages Develpoed and Marketed in India

Name of the software	Organization
WILISYS	WIPRO, Bangalore
SALIM	Uptron India Ltd., New Delhi
LIBSYS	Info-Tek Consultant, New Delhi
GOLDEN LIBRA	Golden Age Software Technologies, Bombay
NILIS	Asmita Consultants, Bombay
ARCHIVES (1,2,3)	Minafax Electronic Systems, Bombay
LIBRARY MANAGER	Systems Data Controls Pvt. Ltd., Bombay
ACQAS, ASCAT, ASCIR, SERAS, ASIRE	Ober Information System, Calcutta

software and application software. System software consists of programmes that enable a computer to function and control its own operations whereas in application software its programmes perform some user specified tasks, e.g. charging books or producing reminders for periodicals, etc. Many library and information centres have developed their own programmes. Besides, there are a number of software packages available for library applications. Some of the widely used and internationally well known packages are: MINISIS, Mini-micro CDS/ISIS, SUPERDOC IV + V, SCI_MATE, CAIRS (Computer Assisted Information/Library Retrieval System), INMAGIC, etc. Some software packages (Table 2) are developed in India and marketed.

Seshagiri [2] while considering the efforts put in the preparation of abstracting journals like Current Contents, Electrical Engineering Abstracts, INPADOC Patent Abstracts, MEDLARS, INSPEC and hundred others has suggested to create two or three software technology parks in India to take up the most of the abstracting services of the world. If this is taken up in India, it will result into massive employment of library and information science degree holders and a hundred enterprises may emerge in the wake of this effort apart from more than one hundred billion dollar earnings.

Computer Networking

Computer application is also facilitating interlinking of libraries or information centres to form a network thereby paving the way for resource sharing. In this, location of resources and services does not matter and each participating library in the network can have access to a pool of resources thereby meeting the expectations and satisfaction of their users.

Storage Technology

The advances in storage technology have a significant effect in information handling. The technology of digital storage is one of the most rapidly changing sector of micro-electronics. Over the last decades operating speeds and reliability have increased substantially along with physical size, power consumption and cost per unit of storage. Similar improvements are predicted in coming years before physical limitations are encountered. The storage technologies include magnetic storage like: Tape/ disk storage, floppy discs, Winchester and removable hard discs, optical storage like compact disk (CD), video disk, digital optical disk (DOD), laser card (LC). Holography is the other optical system. Among these in recent years CD-ROM (Compact Disk Read Only Memory) technology has revolutionalised the information and publishing fields. With the emergence of CD-ROM technology, on-line market seems to have received a jolt.

Recently DIALOG, a reputed vendor of several international data-bases has marketed 'Medline' on single CD-ROM disk which holds medical citations of five years (1984-88). According to a survey 80% of US libraries used CD-ROM in addition to computer and other technologies for information retrieval. The number of data-bases on various subjects in CD-ROM is estimated to be over 350. University Microfilm Inc (UMI) offers five CD-ROM products. 'Dissertation Abstracts' on disk contains bibliographic citations of over 1,000,000 dissertations from 1988 back to 1861 with some 30,000 new citations added each year. ABI/INFORM on DISK is a bibliographic data base of over 800 business periodicals from the last five years. 'Periodical Abstracts on disk' covers 300 general reference periodicals. Other products are Newspaper Abstract on disk and Resource/one[3].

In the case of bibliographic data-bases the users are required to look for the copies of the needed articles. So the producers are now engaged in development of information product on CD-ROM that will contain digital page images. It is estimated that about 5,000 typical magazine pages can be stored on CD-ROM. Earlier, sharing of CD-ROM drive was not possible but recent research and experiments have shown partial success. Micro Medex has succeeded in experimental stage and has announced a next generation system in the form of multi user dial-up system which will be attached to a variety of hosts, i.e. mainframe computer system. Median Data Inc. has CD-Net and CD-Server systems that make CD-ROM drives available as network resources. Compact Disk Interactive (CD-I), Compact Disk Video (CD-V) and Compact Disk Interactive Video (CD-IV) as well as WORM type disks are being produced as storage media.

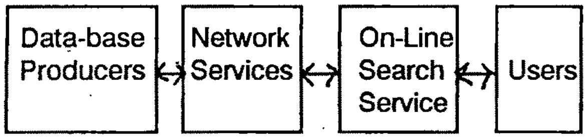
Data-bases

The phrase data-base can take two meanings in literature of L&IS. First of all there are data-bases which are bibliographic or inventory in nature and are nothing more than a collection of related logical records and typified by the sequential type files of LC-MARC, COMPENDEX, NTIS and so on whereas a computer scientist and the Data-Base Management System (DBMS) expert refer to a data-base as a logically consistent structure of interlinked records.

While bibliographic data-bases have been on the scene for more than two decades, on-line bibliographic data-bases are a most recent phenomenon. The following developments have taken place in the field:

a) Computer communication.
b) Public Data Networks.
c) Use of computers in text processing, abstracting and indexing.
d) Data-base management systems and distributed data-base management.
e) Inexpensive communication equipment such as terminals and modems.
f) Data storage system [4].

The major components of an on-line search service are shown in the following chart.



The important data-bases, currently used by the researcher, are COMPENDEX, INSPEC, MEDLINE, ASI (Statistics), MATADEX (Materials Science), METADEX, FSTA (Food), CA-SEARCH NTIS, CANCERLINE, etc.

Telecommunication

Telecommunication is concerned with the transfer of data over distances by means of communication links where communication among a large number of information sources is desired. Direct connection between any two of the large number of sources would obviously be uneconomical and technically difficult. Therefore, the sources must be organized into some form of a network consisting of inter connecting links between locations at which both the transmission and the reception usually occur. Today the links may be implemented in many ways e.g by cable, terrestrial microwave or via earth satellites. For trans-oceanic communications newer forms of submarine cables using optical fibre are being developed.

Certain applications of microprocessors have opened whole new vistas for the transfer of information by telecommunications. The developments of micro-electronics have led to some micro-computers and television based information terminals. Recently there has been considerable activity in evaluation of potential for document delivery systems based on satellite communication. New developments in communication technology such as fibre optics, packet switching and direct/live telecast of satellite transmission are bound to stimulate greater use of communication technology in library and information centres. In India, we are familar with NICNET and INDONET. Research institutes through INDONET's international gateway can get access to a vast electronic library of scientific, technical, financial and commercial information stored in data-bases like MEDLINE, NTIS, INSPEC, COMPENDEX, CLAIMS etc. [5].

INFLIBNET

UGC has worked on a project proposal to have computer communication network in the Eighth Five Year Plan linking libraries and bibliographic information centres all over the country called INFLIBNET (Information and Library Network). It has recently been endorsed by the concerned Ministry of the Government of India. Major institutions of higher learning and national organizations are participating in the project, viz. CSIR, ICAR, DRDO, ICMR, DAE, DOE, DOT, Indira Gandhi Centre of Arts, etc. The project is to be implemented in two stages. The first and the second phase, i.e. (April 1990-March 1992) and (April 1992 to March 1994) are estimated to cost Rs. 551.645 and Rs. 955.2 million respectively. INFLIBNET is a multi-service network offering catalogue based services, data-base services, document supply services and communication based services. It will operate at different levels, national, regional, sectoral and local. There will be a national centre for managing and coordinating the affairs of the network. It will use a hybrid version of satellite and terrestrial networking as its communication system [5].

CALIBNET

For the first time in the country 42 major libraries of various scientific institutions, research laboratories, medical colleges and universities in Calcutta would be brought under a computer network called CALIBNET for mutual sharing of information. The feasibility report has already been submitted by the Computer Maintenance Corporation (CMC) to NISSAT which is funding the project.

INFORMATION SYSTEMS

The ultimate aim of the information system in the library and information centres is conceived as a network of different information facilities including bibliographical retrieval, data-base management, data analysis, indexing and text processing system. etc.

There are a number of information systems both at international and national level which aim at providing information services in various subject fields, viz. INIS, AGRIS, DEVSIS, etc.

MICROGRAPHICS

Micrographics is a powerful microforce for records management and information control. It encompasses techniques and methods for compact storage of voluminous information records for high speed searching and retrieval. Today it is possible to record microimages in various microforms such as microfilm, microfiche, ultrafiche and COM (Computer Output Microfilm). In COM, data on magnetic tape are translated into readable text produced on cathode ray tube and printed as films which can be viewed on terminals or used to produce hard copies. Today something about 20% of current periodicals published in hardcopies are available on microfilm.

EXPERT SYSTEMS

Expert systems (ES) are the best known manifestations of Artificial Intelligence (AI). The direct application of ES to information work has been primarily in the area of on-line bibliographic data-base searching. Expert system use AI problem solving and knowledge representation techniques to codify the knowledge of human experts. Some of the ES developed for on line searching are: Answerman, CANSEARCH, Expert Consultation System, ORA, PLEXUS, Ready Reference Thesaurus System, RUBRIC, etc. [7].

VIDEOTEX AND TELETEXT

Basically videotex (Vtx) and Viewdata are interactive systems for transmitting text and graphics stored in computer data-bases via the telephone network for display on television screen. Referral services, Reference Information, SDI type of subject oriented literature reference cum copying (document delivery) services can be more comfortably used over Vtx [8].

Teletext is a pseudo-interactive information retrieval system using one way telecommunication line to carry digitally encoded textual, graphic or computer readable information. Its main advantage is the ability of the system to be updated continuously for a large viewing audience.

ELECTRONIC MAIL

It is a message service using electronics and telecommunications to deliver hard or soft copy of information. The concept of electronic mail covers a wide spectrum of systems and services whose main common feature is that the message are converted to electronic signals for the purpose of transmission. I/O from electronic mail systems can be via video terminal or word processor with printer, a facsimile machine or indeed any data terminal including computer vision and voice communication system.

INFORMATION INDUSTRIES

The Information Business

Today all those who are concerned with information are over-whelmed with the availability of information and are facing difficulty in tapping the right information at the right time. People have realised the concept of selective buying and accessing information through a computer and telecommunication link. It has given scope for entirely new type of industries having information business which are called as 'information industries'. An information industry may encompass product, services and related technologies which are used to create, store, retrieve, manipulate and deliver the information. Diebold [9] has described information industries constituting various combinations of information providers and delivery system providers as follows:

Information Providers are enterprises and organizations that develop and/or control data-bases, libraries and audiovisual programmes.

Delivery System Providers are enterprises and organizations that develop/or control path ways or 'conduits' for information flows or that offer hardware and software systems for delivery of information services.

Information Services are perceived economic values to the user is based upon the delivery of information.

There are many organizations both in India and abroad which have engaged themselves in the information market. To name a few of them are McGraw-Hill, Reuters, Dun & Bradstreet, Institute for Scientific Information from Abroad and Informatics (Bangalore), Technology Information Forecasting and Assessment Council (TIFAC) set by DST and ICICI subsidiary Technology Development and Information Company of India in

(TDICI) in India.

In India the information industry is still in its infancy and it requires proper marketing of its products and customer education. It should build product awareness among early adopters such as researchers, businessmen and policy makers and use heavy sales promotion to entice trial. To start with, these industries should spend 12 to 15% of revenues on marketing and customer education.

INFORMATION MANAGEMENT

The purposeful and systematic acquisition and application of information with the help of suitable information technology are the core ideas behind the concept of information management. Information management comprises disciplines concerned with the study and the effective and efficient management of information resources, products and services as well as the understanding of the involved technologies and the people engaged in this activity. The function of information management today are comparable with those of business management. The skills and the competency required to manage this is as follows:

Managerial skills/expertise: Strategic planning, financial planning and management, human resource management, communication skills, leadership skills, project management, marketing and marketing research.

Technical skills/expertise: Computer hardware acquisition and management or data-base design and management, telecommunication system and management, system auditing, system analysis, information service management, application development and management.

Only by perfecting the skills/expertise in the above mentioned areas it would be possible to manage either the 'information industries' or 'information centres' in the coming century.

CONCLUSION

Today almost every subject field is scrambling to find ways to harness the power of information technology. This is no longer a technological phenomenon but a social one. In the coming century it would be possible to communicate voluminous amount of information in a variety of forms over long distances in seconds. Standard telephone lines and advanced cellular radio technology will provide access to high speed networks that will whisk data, text, graphics and information from one part of the world and send it to another instantly. Expert Systems will be widely used for on-line searching. The Indian Information Industries should aim to emerge as national retailer of selective foreign bibliographic data bases and simultaneously work with close liaison with INFLIBNET and other networks mentioned earlier. They should also engage themselves in the customer needs research and analysis and accordingly go for service development activities. Further the information workers engaged in information industries or information centres should sharpen their skills in information management to operate effectively and efficiently in the new environment. This would also require to make a balance between 'demand' and 'supply' of information.

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DEVELOPMENT OF LIBRARY MANAGEMENT SYSTEM USING MICRO-CDS/ISIS

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Library automation involves aspects of both information retrieval and housekeeping operations. CDS/ISIS, developed by UNESCO, has a number of attractive features which make it suitable for library automation. A prototype circulation control system, developed using CDS/ISIS (Version 2.33), has been reported. Features of three programs written in CDS/ISIS Pascal for circulation control system are described. The design and implementation of sample databases containing book records and user records are detailed. The prototype circulation control system performs satisfactorily with sample databases containing 3,005 book records and 207 user records respectively on a local area network (LAN). A system developed using CDS/ISIS Pascal for online help containing basic guidelines for searching by author, title, borrower and subject is also reported. Considering the specific network features of Version 3.0 of CDS/ISIS, concluded that the prototype system will work satisfactorily on a LAN.

INTRODUCTION

Library automation helps in providing efficient and quick library services; it is economical because it saves human labour, eliminates duplication of jobs, processes the data and performs many other operations of a library. Automation is more helpful in the routine jobs of a library. The size, nature and the specific needs of the library are to be considered first, which will then help to identify the areas to be automated.

The different areas of automation in libraries can be classified into two main groups as:-

1. Housekeeping operations, viz., acquisition, circulation control, serials control, etc., and
2. Information retrieval services, viz., cataloguing, indexing, current awareness service (CAS), selective dissemination of information (SDI), retrospective search service, etc.

A suitable system for performing all library operations and services should include the facilities of both text retrieval and database management operations; for example, in a circulation control system information is to be extracted from more than one file, etc., which resembles to typical database management operations, whereas cataloguing, indexing, etc., exemplify typical text retrieval operations. Such systems are called library management systems. These systems are usually created on a relational database management framework which allows to handle more than one related data files which are particularly useful for a number of library house-keeping operations. These systems also provide some text retrieval features with particular reference to wide range of search facilities, etc.

Micro-CDS/ISIS has been designed by UNESCO as a text retrieval package, but it has some features which are comparable to database management systems. Based on the hypothesis that CDS/ISIS can be used to develop a library management system, a set of programs were developed using CDS/ISIS Pascal (Version 2.33). A prototype circulation control system and a system for online help were developed using these programs. This paper describes features of these systems.

MICRO-CDS/ISIS

CDS/ISIS is a menu-driven generalized Information Storage and Retrieval System designed specifically for computerized management of structured non-numerical databases. Although CDS/ISIS deals with text and words, and offers therefore many of the features normally found in text management packages, it does more than just text processing. This is because the text that CDS/ISIS processes is structured into data elements that one defines.

CDS/ISIS is now used by about 120 institutions in its mainframe version and more than 5,000 in its mini-micro-version [1]. News related to CDS/ISIS can be found in the form of a regular column in

```
Field Definition Table (FDT)                          Data Base:   BOOK

 ----------------------------------------------------------------------
| ?| Tag| Name                    | Len  | Typ  | Rep  |Delimiters/Pattern|
|__|____|_________________________|______|______|______|__________________|
| -   2   Name of author(s)         200    X                              |
| -   4   Title                     300    X                              |
| -   6   Edition                    10    X                              |
| -   8   Imprint                   100    X              abc             |
| -  10   Series                     70    X                              |
| -  12   ISBN                       20    X                              |
| -  14   Price                      10    X                              |
| -  16   Keywords                  305    X                              |
| -  18   Class number               12    X                              |
| -  20   Copy                        4    N                              |
| -  22   Issue status               25    X                              |
| -  24   Location                   23    X                              |
| -  26   Borrower number            12    N                              |
| -  28   Borrower name              70    X                              |
| -  30   Borrower department        30    X                              |
| -  32   Date of issue               8    N                              |
| -  34   Date of return              8    N                              |
| -  36   Reservation1               12    N                              |
| -  38   Reservation2               12    N                              |
| -  40   Document number            14    N                              |
|_________________________________________________________________________|
```

Figure 1: FDT of the Book Database

```
Field Definition Table (FDT)                          Data Base:   USER

 ----------------------------------------------------------------------
| ?| Tag| Name                    | Len  | Typ  | Rep  |Delimiters/Pattern|
|__|____|_________________________|______|______|______|__________________|
| -   10  Name                      100    X                              |
| -   20  Expiry date                 6    N                              |
| -   30  Status                     23    A                              |
| -   40  Loan limit                  5    N                              |
| -   50  Department                 52    X                              |
| -   60  Total items borrowed        5    N                              |
| -   70  Borrower number            12    N                              |
|_________________________________________________________________________|
```

Figure 2: FDT of the User Database

many journals. For example, news about CDS/ISIS is published in the UNISIST Newsletter, distributed without charge by UNESCO-PGI [2]. Hopkinson [3] has started a column about CDS/ISIS in the journal Information Development. Besemer [4] has also started a column about CDS/ISIS in the journal IAALD Quarterly Bulletin.

REVIEW OF LITERATURE

A number of publications on different aspects of Mini-Micro-CDS/ISIS have come out over the last few years. Features of Micro-CDS/ISIS have been published in different sources [2,5,3,6,7,8,9,10]. Muckhich [11] compares different versions of CDS/ISIS. Lang [12] describes installation problems of micro-CDS/ISIS. There are two reports [13,14] on training course on CDS/ISIS. Goyal & Kumar [15] and Ximin [16] describe the conversion of DBF file into Micro-CDS/ISIS whereas Nowak & Trawinski [17] compare the application properties of Micro-CDS/ISIS and dBASE III Plus packages.

INSERM (Institut national de la sante' et de la recherche medicale) offers a Questel Plus-CDS/ISIS interface for the use of SDI MEDLINE-diskettes under the mini-micro CDS/ISIS software package [18];

ACCESS is a new user-friendly interface, developed by Asian Institute of technology in Bangkok, fully compatible with Mini CDS/ISIS Version 2.3 [19];

European Organization for Nuclear Research (CERN) has developed, through international cooperation, a High Energy Physics (HEP) Preprints Bibliographic Database (PREP) which is indispensable source of current information for HEP. Micro PREP, based on Mini-micro CDS/ISIS, has been developed to facilitate the participation from less developed countries [20]. Gupta [21], Choudhury [22], Torocsik and Fekete [23], Kasper [24], Puntodewo [25], Hariharan and Rao [26], Mittal [27] and Novak [28] describe automated indexing using CDS/ISIS, hyphenated and numeric words indexing using CDS/ISIS, an application of CDS/ISIS in the Sci-tech Library of the Bigal Pharmaceutical works. The registration of library users based on CDS/ISIS, the creation of map catalogue using CDS/ISIS. design and the printing of the Union Catalogue of Seminar and Conference Proceedings, creation of subject index to NUCSSI (National Union Catalogue of Scientific Serials in India) database using CDS/ISIS and the use of Micro-CDS/ISIS database as an OPAC.

A number of databases in different subject fields are designed using CDS/ISIS, i.e. a database of a directory of Asian mycorrhizologists [29], Tata Energy Research Institute's (India) database [30], National Index of Translations database [31] user friendly bibliographic database for cement and building materials [32]. CINTI (Central Institute for Scientific and Technical Information) in Sofia, has developed a database containing English bibliographic and reference information on Bulgarian scientific medical literature, using Mini-micro CDS/ISIS software [33]. Treolar [34] describes a database containing plant information using CDS/ISIS.

DESIDOC software team has developed a library automation package, called SANJAY, using CDS/ISIS, Version 2.3 [35]. The package can be used for normal information retrieval operations like cataloguing, CAS, etc., as well as for house-keeping operations, viz. acquisition and circulation control. The package has been designed to work in a library with medium size collections and users.

DISTINCT FEATURES OF CDS/ISIS

The text that CDS/ISIS processes is structured into data elements that the user defines. However, the unique characteristic of CDS/ISIS is that it is specifically designed to handle fields of variable length. Thus it allows an optimal utilisation of the disk storage and also a complete freedom in defining the maximum length of each field. Another unique feature of CDS/ISIS is that it allows linking of different records of a database. For example, the REF function is a device which allows to gather data which is stored in different records in the database, and appears to the user as if stored in the same record. CDS/ISIS allows data independence, for example, users can build different application programs using data from different databases without having the database structure altered for each application. CDS/ISIS makes provision for data security; users' access to a database can be restricted by using passwords. CDS/ISIS has the following merits which make it more attractive:

- It is available free of charge;
- It runs on a wide range of micros from IBM PC/XTs upwards;
- Version 2.33 can be mounted on Local Network (LAN), as has been done in the Department of Information Studies, University of Shefield, using Novell Netware Systems;
- It allows 16 millions records in a database;
- Menu jump keys are provided to select

```
------------------------------------------------------------------
|                                                                |
|Service ISISENT        Data Entry Services            Menu EXE1|
|                                                                |
|                                                                |
|                     L - Change dialogue language               |
|                     W - Select another worksheet               |
|                     N - Create new record                      |
|                     E - Edit record (or range)                 |
|                     R - Edit last search results               |
|                     D - Define default values                  |
|                     P - Recall last record modified            |
|                     C - Clear default values                   |
|                     I - Issue of documents                     |
|                     T - Return of documents                    |
|                     V - Reservation of documents               |
|                     X - Exit                                   |
|                                                                |
|                                 ?                              |
|                                                                |
|________________________________________________________________|
```

Figure 3: Modified Data Entry Services Menu

```
-----------------------------------------------------------------
|                                                               |
|Service ISISRET    Information Retrieval Services    Menu EXGEN|
|                                                               |
|                                                               |
|                   L - Change dialogue language                |
|                   B - Browse master file                      |
|                   T - Display terms dictionary                |
|                   S - Search formulation                      |
|                   D - Display search results                  |
|                   G - Execute previous search                 |
|                   F - Change display format                   |
|                   R - Recall query formulation                |
|                   P - Save search results                     |
|                   H - Online help                             |
|                   Q - Issue/return query                      |
|                   X - Exit                                    |
|                                 ?                             |
|                                                               |
-----------------------------------------------------------------
```

Figure 4: Modified Information Retrieval Services Menu

directly the most frequently needed functions;
- When a menu is displayed, it shows the database status information containing name of the currently selected database, display format and worksheet as well as the total number of records available in the database;
- It has multi-lingual facilities;
- It has the Advanced Programming Service which can be used to write a program, using CDS/ISIS Pascal, for specific requirements;
- It has provisions for redesigning the system menus to suit the local needs;
- User-defined display format and print format are available;
- A particular or a range of record(s) can be browsed; term dictionary can be displayed for choosing search terms, etc.

The Prototype Circulation Control System

In a circulation control system, information from two types of records, viz. documents and users, are required. In order to make the circulation control system efficient, prompt access to desired records is necessary. The master file structure in CDS/ISIS facilitates easy access to a given record.

Features of Sample Databases

There are two options for creating databases in the context of circulation control system - two databases can be created, one each for user and document records, or records containing information on users and documents can be kept in one sequence in a database. However, creation of two separate databases seem to be more useful for many reasons, some of which are:-

- Owing to the relatively smaller size of both the databases, file handling is relatively easier;
- each database can be used for different purposes without having to be concerned with the other. For example, the 'book data base' can be used for different purposes like information retrieval, circulation control, acquisition, etc.; the 'user database' can be used for CAS, SDI, etc., as well as for circulation control.
- the same software for circulation can be used for the central library as for branch or departmental libraries, wherever they exist. In India this is quite common where users are allowed to borrow items from the university central library, while they can also borrow items from their own departmental library having a separate collection within the building of the department and severed by full-time library staff.

Keeping these points in view, two sample databases, viz. 'book database' and 'user database' have been created, containing 3,005 records and 207 records respectively, in CDS/ISIS. The generalized nature of CDS/ISIS allows databases to be defined for specific requirements. The sample databases were designed in accordance with the provisions laid down in the manual [36]. The fields chosen for both the sample database have been kept simple, while covering the most common features of document and user records. Figures 1 and 2 show fields corresponding to the book and user records respectively. However, the fields can be altered or extended according to a particular need.

A given record in a book database usually contains bibliographic information from field tag 2 through 24 and field tag 40 (Figure 1). Five fields, viz. date of issue, date of return, borrower number, borrower name, and borrower department have been kept to hold data for circulation control in the book record. In the book records, which constitute book database, field tags 2 to 24 and 40 will contain book data, whereas the other fields will remain empty. When a particular book is issued only then the above five fields are automatically filled in by the Issue Program (Section 3.2.1). Similarly, when the given book is returned, these five fields are automatically made empty by the Return Program (Section 3.2.2). Two other fields in the book database, viz. reservation1 and reservation2 contain data only when the given book is reserved by users. Therefore, as in case of the five other fields mentioned above. these two fields remain empty when book records are created. When a book is reserved, these fields are automatically filled in by the Reservation Program (Section 3.2.3).

Thus, user can easily determine, by displaying a given book record, whether it is on loan, to whom, when due, etc. When the given book is not on loan, the fields like date of issue, date of return, borrower number, borrower name, and borrower department will remain empty, and therefore, users can easily make out that it is available for loan.

```
 --------------------------------------------------------------------
|                             AUTHOR SEARCH                          |
|                                                                    |
|For searching by GIVEN AUTHOR (e.g., COX, JOHN) follow any of the  |
|search expressions given below:                                     |
|  (1) COX$/(2)  (will retrieve authors whose surname begins with   |
|                COX)                                                |
|  (2) COX, JOHN (will retrieve records by JOHN COX)                 |
|  (3) Use "Display Terms Dictionary" (option T) to select desired  |
|      terms (move cursor and press '*')                             |
|                                                                    |
|For searching by MORE THAN ONE AUTHORS (e.g., BAILEY, J & KING, P)|
|follow any of the search expressions given below:                   |
|  (1) BAILEY, J*KING, P/(2) (will retrieve records by these        |
|                              authors)                              |
|  (2) Use "Display Terms Dictionary" (option T) to select desired  |
|      terms (move cursor and press '*')                             |
|____________________________________________________________________|
N for next page or X to exit
```

```
 --------------------------------------------------------------------
|                             TITLE SEARCH                           |
|                                                                    |
|For searching by GIVEN TITLE (e.g., COMPUTERS AND COMMUNICATIONS)  |
| search expressions may be:                                         |
|  (1) comput$*commu$* (will retrieve records containing both the   |
|                       terms)                                       |
|  (2) comput$*commu$*/(4) (will retrieve records containing both   |
|                           the terms in the title)                  |
|  (3) Use "Display Terms Dictionary (option T)" to select desired  |
|      terms (move cursor and press '*')                             |
|                                                                    |
|For searching by GIVEN TITLE (e.g., INFORMATION TECHNOLOGY OR      |
| COMPUTERS) search expressions may be:                              |
|  (1) (informa$*techn$)+(computers)/(4) (will retrieve records     |
|                                        containing both the terms)|
|  (2) Use "Display Terms Dictionary (option T)";  select terms     |
|      INFORMATION, and TECHNOLOGY by pressing '*' and the term     |
|      COMPUTERS by pressing '+'                                     |
|____________________________________________________________________|
N for next page or P for previous page or X to exit
```

Figure 5: Sample Help Screens

PROGRAMS FOR CIRCULATION CONTROL SYSTEM

CDS/ISIS Pascal is a programming language which is a subset of standard Pascal [36]. Three programs were written using CDS/ISIS Pascal for the prototype Circulation Control System. In writing the programs, the speed and accuracy of the resulting circulation control system were given major consideration.

In a library, issuing and returning functions normally take place on different desks. Hence, three different programs, viz. Issue Program, Return program and Reservation Program have been developed. These programs have been written keeping in view the functions involved in issuing, returning and reservation operations. All the three programs written for circulation control system have been introduced in the 'Data Entry Services' menu. Figure 3 shows the modified 'Data Entry Service' menu.

In a circulation control system, records should always provide current information. This can be accomplished by updating a record every time it is edited/altered. CDS/ISIS allows updating of the master file records while keeping updating of the inverted file pending. CDS/ISIS also allows updating of the inverted file at any desired time interval - daily, weekly, etc. In designing the prototype circulation control system, it has been assumed that the inverted file will be updated daily.

The Issue Program

As soon as the Issue Program is activated, a prompt appears on the screen asking for the Borrower Number. Once the 'Borrower Number' is given, the system performs a number of operations. The system has to take a number of decisions before issuing an item to a borrower. Major functions of the program are :-

- Checks the validity of membership of the particular user; if the user is not a valid member, then the system ends producing the message "You are not a member any more";
- Checks the given user's status (e.g., student, staff, etc.) and simultaneously the user's loan limit;
- Determines the number of items already borrowed by the given borrower; if the borrower has borrowed upto his/her loan limit, the system produces the message You have already borrowed "(then the number of items he/she has borrowed) documents"; "sorry, cannot borrow any more" and comes to an end.

If the user is a valid member and he/she has not reached loan limit, then the system asks for the Document Number. Here, the number of the document intended to be borrowed is to be given. The system then carries out the following functions:

- Checks the document status; if it is a reference item, it produces the message "sorry, reference document cannot be borrowed" and asks for another document number, if any;
- Checks the reservation fields; if the document is reserved, then it performs the following operations, otherwise it goes to the next step:
- Checks the first reservation field; if the given borrower number is found, then deletes the borrower number; otherwise
- Checks the second reservation field; if the given borrower number is found, then deletes the borrower number;

If the document is reserved and any of the two conditions is satisfied then the system goes to the next step, otherwise it produces a message "This document is reserved by some other borrower", and asks for another Document number;

- Determines the date of return considering loan status (overnight, normal, oneweek, etc.) of the document; for example, if the loan status of a document is 'normal', the system automatically assigns the return date by adding 15 days to the 'issue date' which is adapted from the operating system;
- Updates automatically the particular document record with the given borrower number, borrower name, borrower department, date of issue and date of return;

The above steps continue as long as the borrower intends to borrow documents and has not reached the loan limit. If the borrower does not intend to borrow any more items or reaches his loan limit, the system comes to an end. If the borrower reaches his loan limit, a message is produced: "You have already borrowed (the number of items he has borrowed) documents"; "sorry, cannot borrow any more". The system updates automatically the particular borrower record with total items borrowed at this stage.

The Return Program

As soon as the Return Program is activated, a prompt appears on the screen asking for the Document Number. Once the 'Document Number' is given, the system performs the following operations.

- Checks whether the item is reserved by some other borrower; if so, produces the message This item is reserved, thereby reminding library staff to keep the document separate from other documents being returned;
- Updates automatically the document and borrower records by editing the concerned fields (i.e., borrower number, borrower name, borrower department, date of issue and date of return in the book record, and total items borrowed in the user records).

The Reservation Program

As soon as the Reservation Program is activated, the system asks for the Document Number and proceeds as follows:

- Checks the document number;
- Checks the given document's first reserva tion field; if it is not empty, then checks the second reservation field;

1. If the record is retrieved and either of the reservation fields of the given document is blank, the system askks for the Borrower Number. Here, the number of the borrower who is going to reserve that particular document is to be given. Then the system updates automatically the particular document record with the given borrower number.

2. If the fields are not empty, then it produces the message "This document is already reserved by two users".

THE ONLINE HELP SYSTEM

CDS/ISIS does not provide any online help for searching; users, therefore, face difficulties in conducting a proper search. Considering this problem, an online help system has been developed which provides basic guidelines for conducting searches.

The system for 'Online help' has been included in CDS/ISIS by introducing an option H (Online help) in the 'Information Retrieval Services' menu. Selection of the option H will lead users to the online help facilities. Figure 4 shows the modified 'Information Retrieval Service' menu.

Four key areas for search in libraries, viz. author, title, borrower, and subject have been identified. Four help screens have been designed which can be displayed on the screen, users can toggle from one to another by pressing < PgUp > and < PgDn > keys. Each screen contains a few simple search queries followed by necessary guidelines with examples for conducting search. Figure 5 represents two help screens.

CDS/ISIS ON LOCAL AREA NETWORK

CDS/ISIS Version 2.33 is not a network version, but it can be mounted on Local Area Network (LAN), as has been done in the Department of Information Studies, University of Shefield, using Novell Netware Systems. As a result, more than one users can search a database simultaneously through 'Information Retrieval Services' menu. However, a given record cannot be opened for editing simultaneously by more than one users.

In a library, users will search for documents according to their particular needs, and they will want to know about 'issue information' (for example, whether the documents are available for issuing, or they have already been issued to other member; in the latter case who has borrowed the document, when is it due, and so on) of the documents. For example, if a user wants to borrow a document, he/she will try to know whether the particular document is on loan and if so, whether that document is already reserved or not, etc. In the network using Version 2.33 of CDS/ISIS, it is not possible to know about a document which has been issued/returned on the same day; the system will only show data up to that point when the inverted file was updated last time. The current information can only be obtained by displaying the record on the particular terminal where the document has been issued or returned. This is a problem of the system itself. It has been noticed that in order to get the correct data in all the participating terminals in a network, it is necessary to switch off all but one machines where inverted file is to be updated. In a library, this can only be done at the end of the day. Thus it is not possible for the users to get correct 'issue informa-

tion', they can get information current up to the previous day, i.e., the last time the inverted file was updated. However, an attempt has been made, as a part of this study, to sort out this problem. The prototype circulation system creates a temporary file where it keeps records of daily transactions. In order to provide users with current information relating to issue status of a document, a program has been developed which can be called by choosing option Q (Issue/return query) from the 'Information Retrieval Services' menu (Figure 4). When a user asks about the issue status of a book by inputing the 'document number' in response to a prompt, the program looks into the temporary file first and if it does not find there, it then searches the main database (Book database); when the document is retrieved, the system displays data containing brief bibliographic details and issue status of the document.
Version 3.0 of CDS/ISIS provides full LAN support, i.e., simultaneous access to a given database by two or more users for both searching and data entry. Thus the problem stated above can be solved by using this version - current information relating to records which have been issued/returned on that particular day can be obtained by displaying the record (searching through keys like author, title, keywords, etc. whose value do not change during issue/return, as happen in case of keys like borrower number, date of issue, date of return, etc.) on any terminal in the network even if the inverted file update is pending. Successful searches can be conducted through keys like borrower number, date of return, etc., only when the inverted file is updated. Inverted file can be updated at the end of the day. Version 3.0 also allows to update the inverted file while other users are searching the database; however, this will slow down the search.

CONCLUSION

The prototype circulation control system performs satisfactorily in LAN environement where Version 2.33 has been mounted. However, no performance evaluation has yet been undertaken. It is believed that the prototype system will be more suitable for Version 3.0 of CDS/ISIS in a LAN; issue and return function can be performed simultaneously on any number of terminals. This will not affect information retrieval operations performed by users/staff. Experience shows that systems for other housekeeping operations, viz. acquisition, serials control, etc., can be developed using CDS/ISIS Pascal and these systems can be incorporated into a chosen menu in CDS/ISIS. Thus, a complete library management system can be developed using Micro-CDS/ISIS which will facilitate automation of both the information retrieval and housekeeping operations in libraries.

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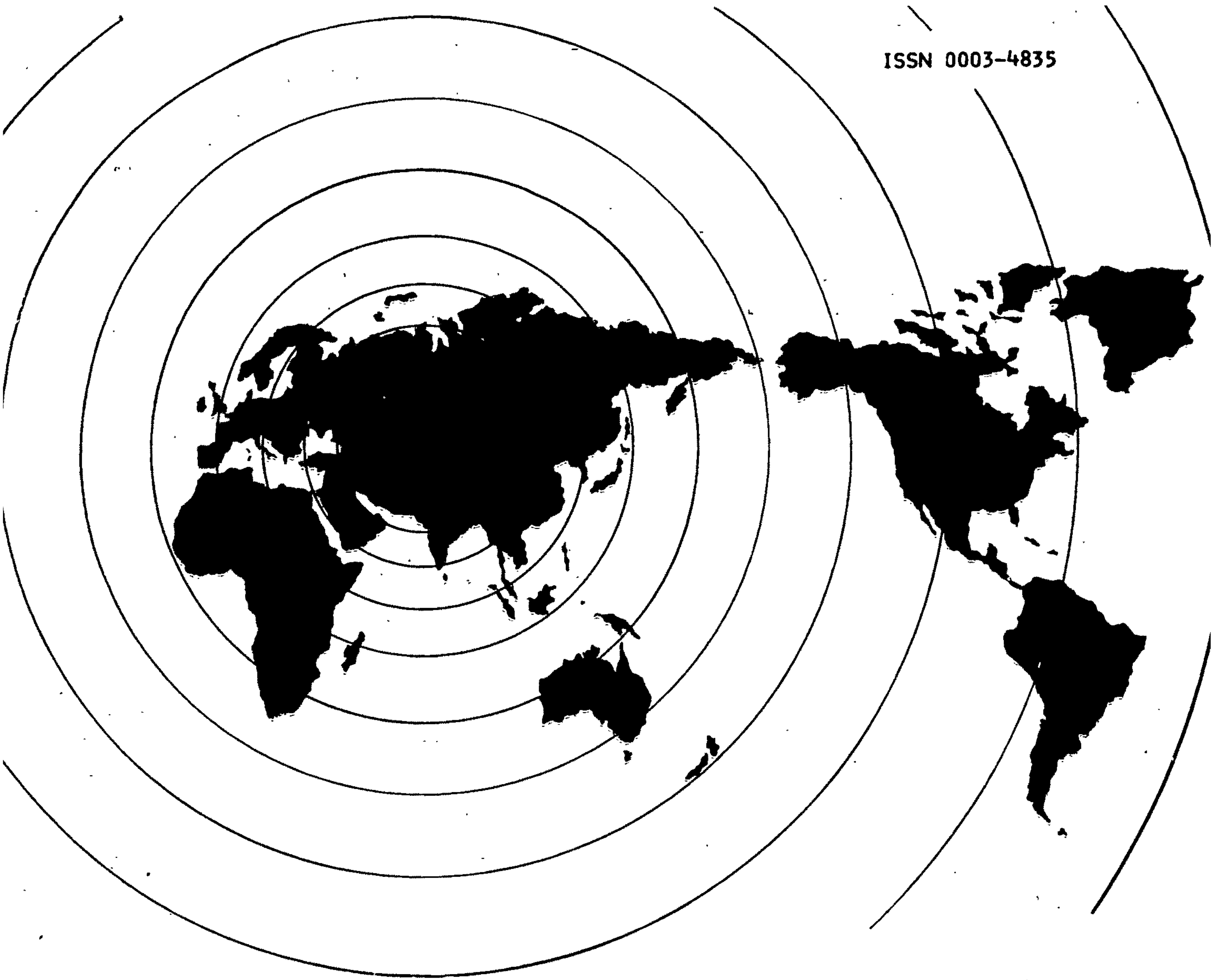

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EDITORIAL

INSDOC and the community of librarians and information scientists in India take pleasure in extending a warm welcome to the fourth meeting of the SAARC Documentation Expert Committee (SAARC-DEC) which is taking place in India during January 21-22, 1993. SAARC - South Asian Association of Regional Cooperation among the seven member nations in the fields of trade, commerce, education, planning, science, technology, etc. is to stimulate and promote all round economic development. Inter alia, SAARC has accorded priority to the development of facilities for handling and exchange of information particularly in the fields of science, technology and industrial development. This is as it should be because information these days, is the primary input for any production/distribution activity. The first step towards the implementation of SAARC Documentation System was the designation of an institution in each member country to serve as a focal point for interaction on the matters relating to the SAARC Documentation System. INSDOC is the designated focal point of the system in India. Similarly, there is BANSDOC in Bangladesh, Royal Institute of Management in Bhutan, Ministry of Planning and Environ in Maldives, Royal Nepal Academy of Science and Technology in Nepal, Pakistan Scientific and Technological Information Centre in Pakistan and Centre for Development of Information (National Planning Department, Ministry of Policy, Planning and Implementation) in Sri Lanka. The focal points are in constant interaction with each other on the matters of procurement and dissemination of information required by the scientific and technological communities of the respective countries.

In this perspective, INSDOC has been making constant efforts to propagate scientific and technical information of particular interest to the SAARC countries by way of subscribing Annals and Indian Science Abstracts on their behalf. The columns of the Annals of Library Science and Documentation are always open to the information scientist experts from SAARC region to share their findings and views with their counter parts in sister countries.

World is witness to momentous changes with countries in various regions banding themselves together for the purpose of closer cooperation in the matters of science, technology and economic development. We have the examples of EEC countries coming together in Europe and Canada and the USA doing similarly across the Pacific. This should naturally be a valuable pointer to SAARC countries to intensify interaction in the areas of mutual interest.

J K Ahluwalia
INSDOC

Annals of Library Science and Documentation 1992, 39(4), 123-33

SOFTWARE DOCUMENTATION AND STANDARDS

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T VISWANATHAN
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Presently, software costs dominate the hardware costs in computer systems. Desire to produce high quality reliable software at low costs has led to the evolution and adoption of engineering principles in the design and development of software. This paper deals with software documentation and standards which occupy an important place in software engineering process. The need of a software librarian as a part of software engineering team is discussed. International standards in software engineering deal with only guidelines. Evolving a standardisation process for an organisation using these guidelines is dealt with. Finally some quality indicators for software documentation are presented.

INTRODUCTION

The last decade of computing recognised software as a new driving force and, in fact, software surpassed hardware as the key element to the success of many computing systems. But the dual problem of high cost and low quality of software remains the main concern of the software engineering community even today. Quality is sacrificed because of cost constraints, or costs are driven up in order to achieve higher levels of quality. Deficiencies ignored during the development stage result in huge costs during the maintenance phase of software systems. It is claimed by Boehm[1] that more than one-half of the total life-cycle costs are incurred during the maintenance phase.

During the past decade software development has evolved into an engineering discipline. Software engineering techniques deal with software as an engineered product that requires planning, analysis, implementation, testing and maintenance. Although solutions to current problems in the domain of software have advanced with the acknowledgement of life-cycle perspective of the development process, management's lack of commitment to educate existing talent in the use of evolving methodologies, techniques and tool continues to contribute to high-cost, low-quality software.

Citing the excessive software maintenance costs, the software engineering community has been able to explain the need for a disciplined development process, controlled through meticulous attention to configuration management and governed by a set of fundamental principles. In practice, these principles are associated with the objectives for a given software development activity and are measurable through associated attributes of the product.

Among these principles is the software documentation: i.e. the recording of the requirements, design, specifications and implementation decisions as they occur with the commitment to convey purpose, content and clarity.

SOFTWARE DOCUMENTATION

Software engineering techniques facilitate an engineering approach to software development. The classical life cycle approach goes through different phases such as requirements specifications, design, coding, testing and maintenance during system development. The documentation of all these activities is necessary. A document is defined as a written record of the completion of a phase of work. Software documentation is a major component of software engineering activity as depicted in Fig. 1. Software documentation comprises the manuals and other descriptive information that portray the use, operation and other major components of the software.

The purposes of software documentation may be categorised into:

- Inter-task/phase communication
- Quality control and project control
- Historical reference
- Instructional reference

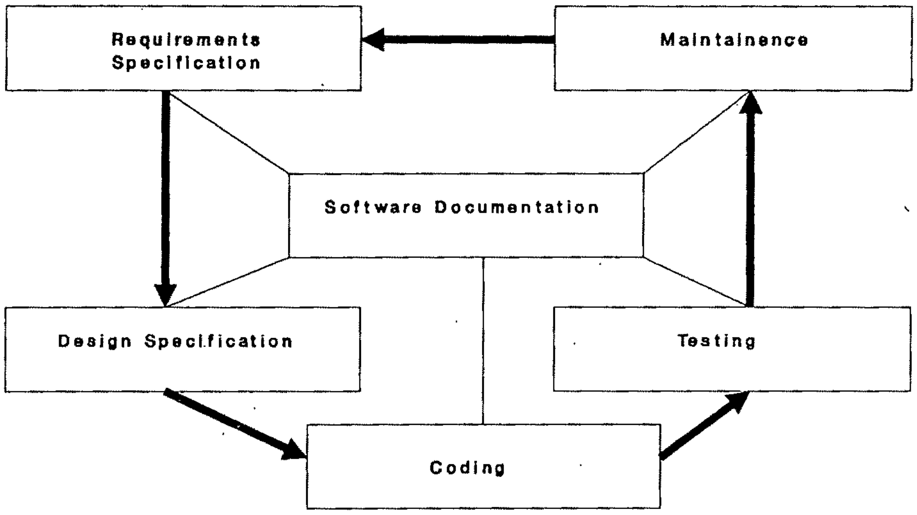

Figure 1

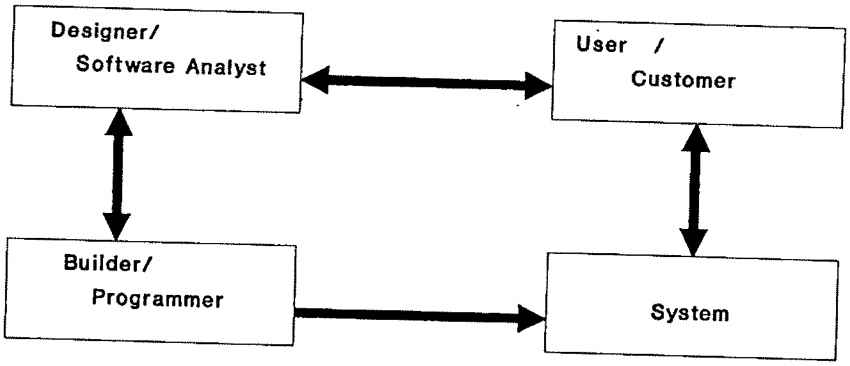

Figure 2

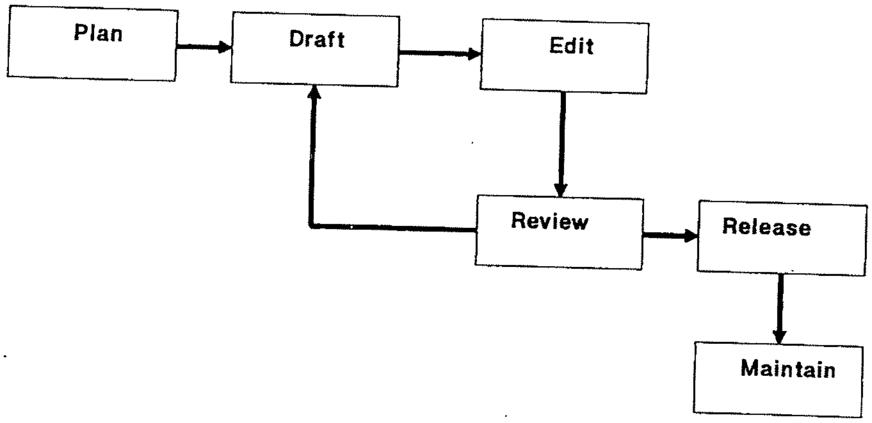

Figure 3

Documentation serves as a communication bridge between the user, the designer and the builder of the system as shown in Fig.2. It has long been recognised that poor or inadequate communication among personnel is a major problem area in software development process. The system analyst communicates with many user personnel during the investigation and analyses of the problem area. The system analyst in turn communicates the program requirements to the programmer, who must specify how the computers must run the program and so on. Without adequate documentation, the initial idea from the user becomes distorted resulting in the final product bearing little relation to the original intention. Documentation is important for quality assurance. As the product proceeds from concept to general design and ultimately into operational form, the only viable way to assess the product is through its documentation. Documentation functions as a source for historical reference and the provisions of a permanent record of work performed and used is an important reference for future modifications. Documentation is also used as a instructional device like user instructions or operator instructions.

A simple model of documentation process is shown in Fig.3.

The first step in the documentation process is planning the document. It consists of three main steps:

- Define the audience, purpose, and subject
- Organise the material
- Design the format

The second step in the documentation process is to create a draft, or working version of the document that has been planned. Once the draft is finished, the next step is to edit it. The purpose of editing is to refine the draft into a usable systems document. When a useful version of the document has been drafted and edited, it has to be reviewed. All documents need to be tested against their document plan to make sure that they meet the criteria defined there. Once the document has been reviewed and perfected, it can be produced in a form that is suitable for distribution to the intended audience. Since information systems are more susceptible to change, revision and updating of system documents are important steps of the documentation process. The most important factors in good document design are:

Orderly development of ideas

- Technical accuracy and completeness
- Logical arrangement of information

Software documentation can be defined as a collection of technical data or information, including computer listings and printouts, in human readable form. This collection describes or specifies the design details, explain the capabilities, or provide operating instructions for using the software to obtain desired results from a software system.

There are standard procedures available for the documentation of activities done during different phases of software development process. The changes made to the system during a particular phase of development should be reflected in all the related documentation components. This is known as concurrent documentation. The principles of concurrent documentation of software implies a continual change to all documentation elements affected by changes at any stage of development, as depicted in Fig. 4. Concurrent documentation is particularly important within the maintenance phase because examination of existing documents may be the only means available to the maintenance personnel to understand the internal details of the software and the original intentions of the developers. As with other software engineering principles, concurrent documentation is crucial to the software development process, and later, to the maintenance activity. Hence, the extent to which concurrent documentation principle is observed must be measurable and controlled. This leads to the problem of determining how one might evaluate the quality of documentation produced during the software development and maintenance phases.

Software documentation can be classified into system documentation and user documentation as depicted in Fig. 5.

System documentation conveys the requirements, design philosophy, design details, capabilities, limitations and other characteristics of a system. User documentation conveys to the end user instructions for using the system to obtain the desired results, for example, a user's manual. System documentation, in addition, can be categorised into four applicational areas as shown in Fig.5.

Software Requirement Analysis documentation

Requirement analysis is the process of allocating software function, in the overall system development process. It enables the system analyst to

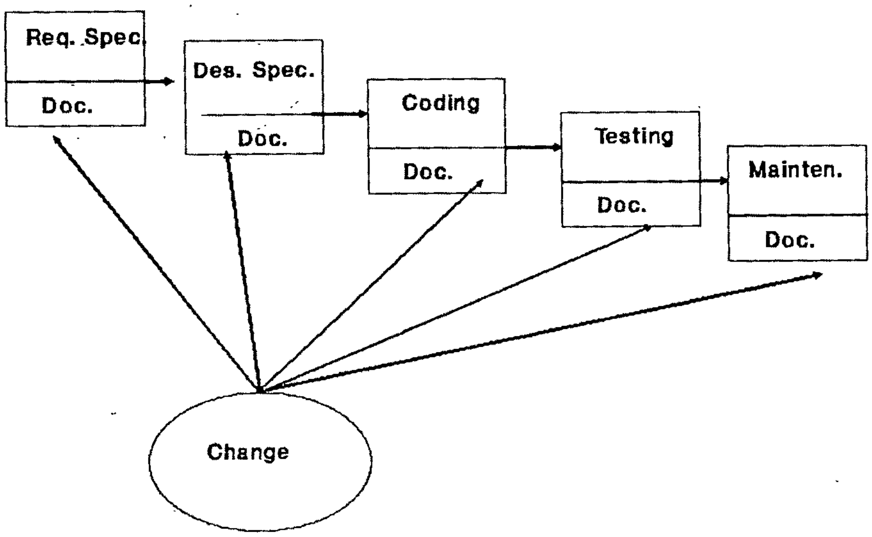

Figure 4

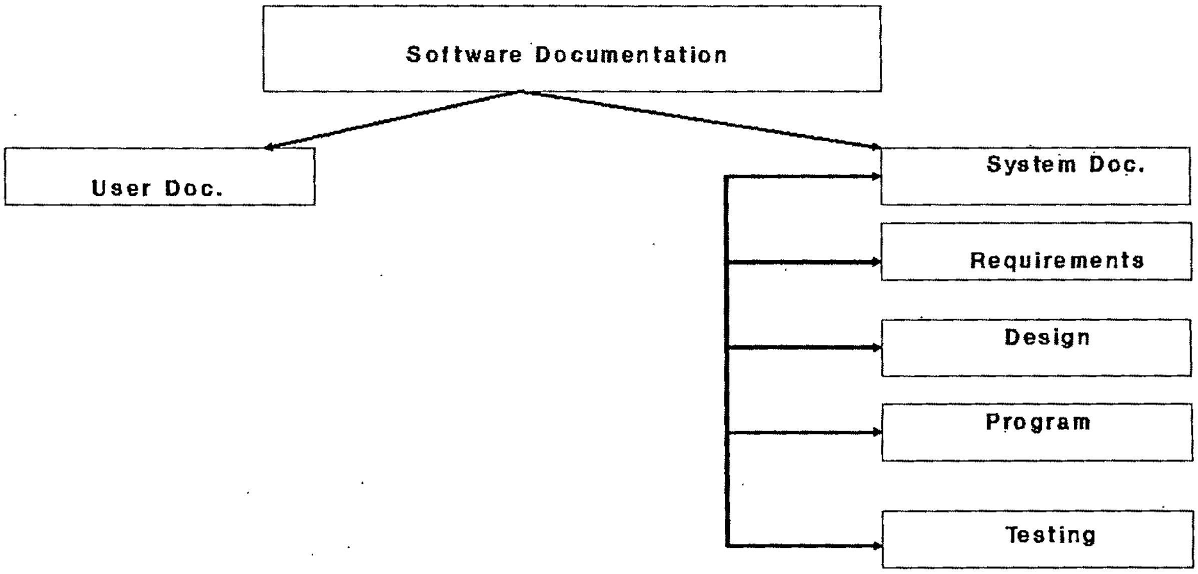

Figure 5

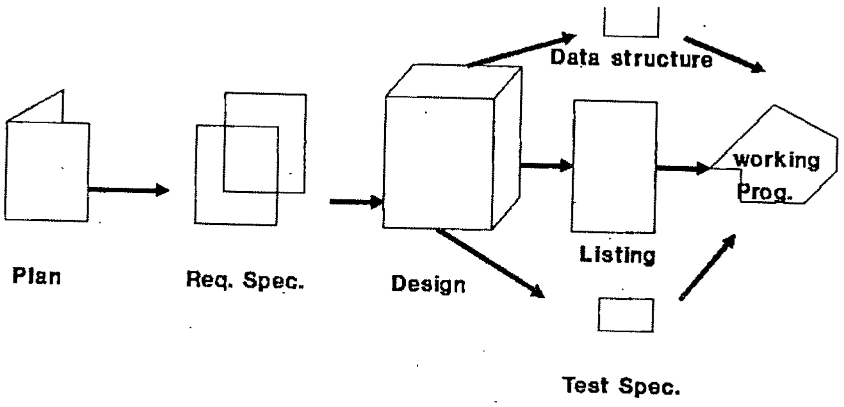

Figure 6

specify software function and performance, indicates software's interface with other system elements, and establishes design constraints that software must meet.

Software Requirements Specification is produced at the culmination of the analysis task. The function and performance allocated to software as part of system engineering are refined by establishing a complete information description, a detailed functional description, an indication of performance requirements and design constraints, appropriate validation criteria, and other data pertinent to the requirements. In general a requirement document should include:

Introduction It states the goals and objectives of the software, describing it in the context of the computer based system.

Information Description - It provides detailed description of the problem the software must solve.

Functional Descriptions - A descrition of each function required to solve the problem is presented.

Validation Criteria - It specifies what classes of tests must be coducted to validate function, performance and constraints.

Bibliography and Appendix - Bibliography contains references to all documents that relate to software. The appendix contains information that supplements the specifications.

ANSI/IEEE Std 830-1984 specifies in detail what are the components of a good requirements document. The guide describes alternate approaches to good practice in the specification of software requirements. To enable the reader to make knowledgeable choices, extensive tutorial material is provided. This covers the attributes of a good software requirements specification itself, as well as specification methodologies and associated formats.

Design Documentation

Software design is a process through which requirements are translated into a representation of software. Software design is conducted in two steps. Preliminary design is concerned with the transformation of requirements into data and software architecture. Detailed design focuses on refinements to the architectural representation that lead to detailed data structure and algorithmic representation for software.

A design document consists of scope of software, reference documents, design description, modules, file structure, global data, requirements cross-references, test procedures, etc. The documents should specify the necessary information content. A software design document is a representation of a software system that is used as a medium for communicating software design information. ANSI/IEEE Std 1016-1987 specifies an organisation for a software design description.

Program Documentation

Program documentation comprises the records of the detailed logic and coding of the constituent programs of a system. It is prepared by the programmer and aids:

- Program development and acceptance
- Trouble shooting
- Program maintenance
- Machine conversion
- Programmer change over

For the purpose of program documentation, the following guidelines are useful:

- heading comments for the main program and each subroutine to provide the reader with an overall information about the program structure and logic, and with a concise description of the functions of each component.

- current comments strategically placed within the program to identify logical divisions or blocks, to clarify programs statements, and to point out deviations from the standard programming language, if any.

Program documentation should contain details such as: who developed the code and when, who made the changes and why, what changes are made and when in a chronological order.

Test Plan Documentation

The preparation of a program test plan is a fundamental technique of program validation methodology. A test plan is essentially a schedule of sequence operations to test a program. The test plan incorporated in the program manual should nominally comprise:

- A summary of method
- List of test cases, sequence of appli-

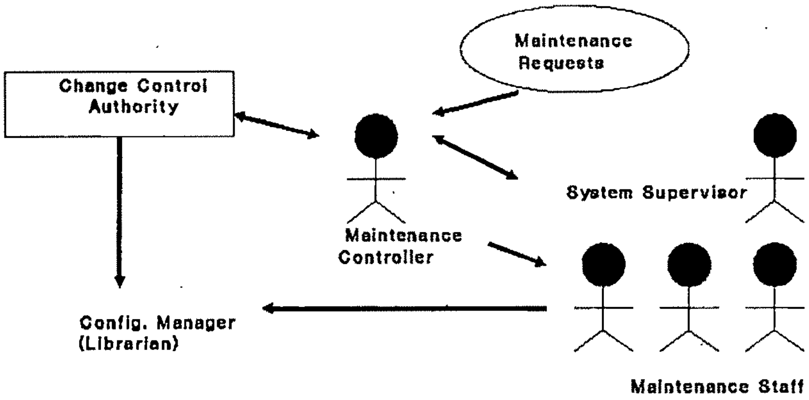

Figure 7

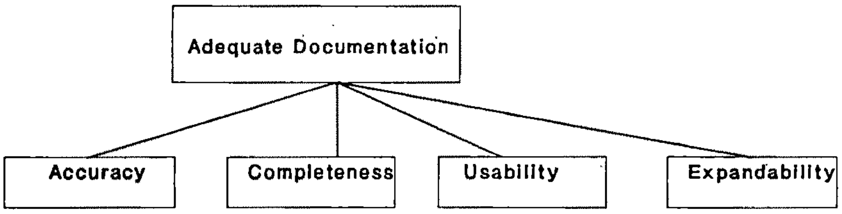

Figure 8

cations and expected results
Listing of a test data

ANSI/IEEE Std 829-1983 specifies the contents of a test documentation. The standard addresses the documentation of both initial development testing and testing of subsequent releases. The documents outlined in this standard cover test planning, test specifications, and test reporting. The test plan prescribes the scope, approach, resources and schedule of testing activities. It identifies the items to be tested, the features to be tested, the testing tasks to be performed, the personnel responsible for each task, and the risks associated with the plan. The standard shows the relationships of these documents to one another as they are developed, and to the test process they document.

SOFTWARE DOCUMENTATION AIDS

The most common type of software documentation aid is the automatic flowchart generator or flowcharter. These fall into two main groups. The first group operates on ordinary source programmes together with a few special parameters to produce detailed logic flowcharts. The second group accepts special parameters plus a program description and from these, an outline flowchart is produced. The first group of flow charts are called post coding flowcharts, and are valuable aids for program maintenance. The second group of flow chart can be called as precoding flowcharts. A flowcharting package can also produce reference listings.

Automatic Software Documenter is one such package developed by the firm COSMIC, Georgia and works on HP-9000 systems. This software provides automated drafts of documentation directly from C source code in the Unix environment. This is specifically designed to simplify and streamline program documentation. BOS/HLP is another package which helps to create on-line documentation interactively. Documentation Aid from Allen systems group generates and helps to maintain job documentation, provides on-line retrieval, and cross-referencing. All flowcharters available transcribe the sequential program flow. Some, however, have the option to present the logic in a different form. For example, AUTOFLOW from Applied Data Research Inc. automatically analyses the program, determines which logical units of code are related, and, whenever possible, places these blocks of logic together on the chart, regardless of their input sequence. DOCUMATIC from Data usage Corporation, USA does not produce detailed flow chart as such but an outline system pictorials(inputs, outputs, and process box) together with a narrative description of processing.

USER DOCUMENTATION

User documentation is the hardcopy or on-line documentation provided with an application program. It tells the user how to get the program up and running, trains the user in its operation, and provides reference information once the user becomes experienced.

User documentation is extremely important. It will make the difference between whether a program can be used effectively or not. User documentation is increasingly becoming a selling point for software products.

User Documentation development process consists of the following steps[3].

a) Form the documentation development team
b) Make user documentation match
c) Prepare documentation plans
d) Develop documentation standards
e) Develop management plan
f) Create documentation
g) Conduct technical review
h) Conduct user evaluation
i) Create final draft.

The larger and more complex the program, it is more likely that it will need several separate documentation components to fulfill various needs of its audience. The documentation developer must decide what components are needed in the function to be fulfilled by each.

User documentation comes in two forms: internal and external. Internal documentation consists of help screens, directions and other explanatory information that the operator can access within the program. External documentation is outside the program itself. Its most common form is user's guide.

All user documentation has the same purpose: to explain the features of the program and help the operator gain proficiency in using it. The most common forms of external documentation probably are the program user's guide, quick reference card, quick reference guide, and job performance aid. The most common forms of internal documentation probably are the help screen, tutorial and guided tour.

A user documentation system is a set of interdependent documentation components designed to support the user in learning and using the program.The various components have different purposes and support this goal in different ways, but all, in one way or another support the ultimate goal.

The major components are

- On-line help (provide fast access to key commands and procedures)
- Tutorials (trains new users)
- Reference manual (provides detailed reference information)
- Job performance aid (summarizes key procedures)
- Guided tour (provides program over view)
- System set up information (tells how to configure program)
- Quick reference card (provides key reference information)

ANSI/IEEE Std 1063-1987 is the standard for Software User Documentation. This standard provides minimum requirements on the structure and information content of user documentation. It deals primarily with the technical substance rather than the style. Users of the standard may develop their own style manual for use within their organisations to implement the requirements of this standard.

SOFTWARE LIBRARIAN

Concurrent documentation facilitates consistency in documents. During maintenance phase and other phases of development process, the changes attributed to one document should reflect in other documents also. Otherwise, inconsistency will result and defeats the purpose of documentation.

To ensure the quality and reliability of the software, one will have to be authorised to monitor and control the changes attributed at the maintainance phase of the software development. The answers to the questions, such as :

- How does an organisation identify and manage the many existing versions of a program (and its documentation) in a manner that will enable change to be accomodated efficiently?

- How does an organisation control changes before and after software is released to a customer?

- How does one ensure that changes have been made properly in all related components?

lead to the concept of a software librarian or configuration manager. The outputs of a software engineering process are collectively called soft ware configuration , as depicted in Fig.6..

Software configuration management is a set of activities developed to manage changes throughout the software life cycle. It is a software quality assurance activity. ANSI/IEEE Std 828-1990 gives the standard for software configuration management planning. The purpose of this guide is to provide guidance in planning software configuration management (SCM) practices that are compatible with ANSI/IEEE Std 828-1983. The guide focuses on the process of SCM planning and provides a broad perspective for understanding software configuration management [4].

In a software development process a software librarian is responsible for keeping all the documents related to a software development process. He is a part of the software maintainance/ development team (Fig.7) Whenever changes are made to one document, software librarian is responsible for making the related changes to all documents. He constantly interacts with maintenance staff, development teams, system supervisor, review team, testing team etc. The librarian acts as a controller, coordinator and potentially an evaluator of the software configuration.

The responsibilities of a software librarian are to maintain custody of programs, files, documentation, magnetic media; help collect and format software productivity data, catalogues and indexes revisable and reusable software module, and assist the team in research, evaluation, and document preparation.

He is also responsible for concurrent documentation, i.e. issue of these resources based on authorized schedule of use or special authorisation. He schedules changes to production applications after completion of testing and maintains records of the changes.

Even though a large number of software packages are available for document preparation and maintainance there is no software available to ensure the changes made in one document automatically leads to changes in other related documents.

INTERNATIONAL STANDARDS

For ensuring quality of software products, standards organisations such as IEEE and ISO have come up with standards for different software engineering activities. A list of the latest standards from IEEE[2] are given in Appendix-I

The Standards from International Standards Organisation(ISO) give another set of guidelines for software documentation. The standard ISO 9000 is for quality systems and gives a model for quality assurance in design/development, production, installation and servicing. It has three parts:

Part 1.	ISO 9001 Specification for design/development.
Part 2.	ISO 9002 Specification for production and installation.
Part 3.	ISO 9003 Specification for final inspection and test.

ISO 9000-3:1991(E) sets out guidelines, to facilitate the application of ISO 9001 to organisations developing, supplying and maintaining software.

BS ISO/IEC TR 9294:1990 - Information Technology - Guidelines for management of Software Documentation gives the specific guidance on the Management of software documentation to those managers responsible for the production of software or software based products.

DEVELOPMENT OF DOCUMENTATION STANDARDS

There is no universal documentation system which is valid for all environments. Development of documentation standards should, to a large extent, be a process of adaptation rather than origination. The standards available from IEEE and ISO act as guidelines. For example, ANSI/IEEE Std 1002-1987 explains the Taxonomy used in software engineering standards, their functional and external relationships and the role of various functions participating in the software life cycle. This Taxonomy may be used as a method for planning the development or evaluation of documentation standards for an organisation. There are three phases in evolving documentation standards[5] :

- preparatory phase
- development phase
- post implementation phase-audit, maintenance and support.

Three major preparatory tasks in the preparatory phase are:-

- workout project organisation and allocate resources.
- define scope of standards program.
- define the architecture or organisation of manuals.

Development phase as such contains the actual standard development process. It is necessary to:

- Provide the groundwork for development of each standard.
- Determine the formal and informal practices in effect.
- Gather data for comparison of the various approaches or possible solutions.
- Establish priority of needs and probability for successful implementation.

It also involves the draft preparation, distribution of draft etc. In post-implementation phase, procedures must be formulated to review and maintain the standards.

The output of the standard developments program should be:

- A manual for documentation standards
- A maintenance and support program
- A training and implementation scheme

DOCUMENT QUALITY INDICATORS

Arthur & Stevens[6] described a method for evaluating the adequacy of predefined, static sets of documentation relative to the system that it purportedly describe.The primary, high-level qualities of good documentation are: accuracy, completeness, usability and expandability. Qualities are the abstract characteristics of adequate documentation, yet, essential to its definition. As shown in Fig. 8, qualities are the nodes directly under and most closely tied to the even more abstract notion of adequate documentation.

Although intangible, the identified qualities most closely convey the meaning of adequate documentation. For the purpose of clarity, a brief description of all four qualities are given below:

Accuracy : The common definition for 'accuracy' is the freedom from mistake or error; a synonym is 'correctness'. Within the context of computer documentation, accuracy can be defined as the consistency among the code and all documentation of the code for all requirements. That is, accurate documentation should reflect the realized state of the system that it represents.

Completeness : The standard definition for 'completeness' is the possession of all necessary parts, elements, or steps. For the purposes of computer documentation, a set of documentation is complete if all of the required information is present.

Usability : The dictionary definition for usability' is the capability, convenience, or suitability of being employed. Relative to assessing documentation quality, usability is more appropriately defined as the suitability of the documentation relative to the ease with which one can extract needed information.

Expandability : A general definition for expandability is the ability to increase an object's extent number, volume, or scope. A synonym is 'extensibility'. The rationale for including expandability as a desirable quality is to reflect concepts underlying document maintainability, and in particlar the ease with which thedocumentation can be added to and modified. In concert with the notion of document maintainability, a more precise definition for expandability is: the capability of the documentation to be modified in reaction to changes in the system.This quality is assessed through measures reflecting ease of modification.

SUMMARY

Latest standards in software engineering, with particular emphasis on documentation is discussed here. The needs of documentation and its various components are discussed in detail, from the view point of software engineering. System documentation, an integral component of software documentation, conveys the requirements, design philosophy, design details, capabilities, limitations and other characteristics of a system while user documentation, another component of software documentation conveys to the end-user instructions for using the system to obtain desired results. The principle of concurrent documentation emphasises that the changes made to the system during a particular phase of development should be reflected in all the related documentation components. This brings out the need for a software librarian, which has been discussed in detail in this article. A universal documentation system which is suitable for all types of organisation is not available; but each organisation can develop its own standard documentation procedures from the guidelines given by the standards available.

For evaluating the adequacy of a document, a set of quality indicators such as accuracy, completeness, usability and expandability are to be given due importance.

ACKNOWLEDGEMENTS

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APPENDIX-I

List of latest standards from IEEE

ANSI/IEEE Std 729-1983	- Glossary of Software Engineering Terminology
ANSI/IEEE Std 730-1989	- Software Quality Assurance Plans
ANSI/IEEE Std 828-1990	- Software Configuration Management Plans
ANSI/IEEE Std 829-1983	- SoftwareTest Documentation
ANSI/IEEE Std 830-1984	- Guide for Software Requirments Specifications
ANSI/IEEE Std 982.1-1988	- Standard Dictionary of Measures to Produce Reliable Software
ANSI/IEEE Std 982.2-1988	- Guide for the Use of IEEE Standard Dictionary of Measures to Produce Reliable Software (IEEE Std 982.1-1988)
ANSI/IEEE Std 983-1986	- Software Quality Assurance Planning
ANSI/IEEE Std 990-1987	- Ada As a Program Design Language
ANSI/IEEE Std 1002-1987	- Taxonamy of Software Engineering Standards
ANSI/IEEE Std 1008-1987	- Software Unit Testing
ANSI/IEEE Std 1012-1986	- Software Verification and Validation Plans
ANSI/IEEE Std 1016-1987	- Software Design Descriptions
ANSI/IEEE Std 1028-1988	- Standards for Software Reviews and Audits
ANSI/IEEE Std 1042-1987	- Guide to Software Configuration Management
ANSI/IEEE Std 1058.1-1987	- Standard for Software Project Management Plans
ANSI/IEEE Std 1063-1987	- Standard for Software User Documentation

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INTER LIBRARY LOAN SERVICE IN AGRICULTURAL LIBRARIES IN INDIA

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Importance of inter-library loan service is stressed. Inter-library loan relations of the agricultural libraries is studied. The type and number of documents borrowed and lent is discussed including the response. Certain steps for effective inter library loan service are suggested.

INTRODUCTION

Library is a growing organism and no library is self sufficient enough to procure all the documents of its interest [5]. A large number of institutions in the world are actively engaged in increasing agricultural production and, therefore, they are the generating points of agricultural information. Access to all the information produced by them is not possible by any single library. It is, therefore, obligatory on the part of libraries to cooperate with each other for inter-library loan [3].

Inter-library loan service is a courtesy offered by a library to another. The standing committee of IFLA in its guidelines for inter-lending, also recommended that each country should have a centre for international lending [2].

The success of the service depends upon the cooperation of the participating libraries and the individuals. Sharma and Varma [6] suggested that the libraries which are richer in their collection should come forward to help their counterparts which are deficient in book collection. It is further suggested that some national or international inter-library loan code may be adopted for specification of the reading materials to be lent.

OBJECTIVES

The objectives of the study are to find

a) the popularity of the inter-library loan service in agricultural libraries,

b) the types of documents borrowed and lent and

c) the response of libraries to borrowing the documents.

METHODOLOGY AND SCOPE

Sixty eight libraries of the agricultural university establishments, 62 libraries attached to the ICAR institutions and 22 other research institute libraries were approached to furnish the information with the help of questionnaire. 65 percent of the libraries responded and the results thus obtained are analysed.

POPULARITY OF THE SERVICE

Seventy six percent of the agricultural university main campus libraries (AUML), 63 percent of the off campus agricultural college libraries (OACL) and 60 percent of the off campus veterinary and fishery college libraries (OVCL) have established good relations with other agricultural libraries in India for borrowing and lending of documents.

Among the libraries of ICAR institutes, all the libraries attached to the national research institutes (NRIL), 91 percent of the discipline oriented research institute libraries (DRIL), and 80 percent of the commodity research institute libraries (CRIL) and 64 percent of the libraries attached to other research institutes of miscellaneous interest have established good contacts with other libraries for borrowing and lending of documents.

In general, around 73 percent of the agricultural libraries have established good relations with each other. Thus a healthy precedent is set up by the national research institute libraries which needs to be emulated by all other libraries.

The data relating to thenumber of inter library loans in a number of agricultural libraries is lacking. However, a few libraries have maintained the statistics. There are eleven such agricultural libraries with the number of contacts ranging from 10 to 100 per institute.

BORROWING OF DOCUMENTS

All AUML, 40 percent of the OACL and 83 percent of the OVCL, all NRIL and CRIL and 90 percent of the DRIL were found borrowing documents from other libraries. Seventy one percent of the libraries attached to other research institutes of miscellaneous interest also reported borrowing documents.

Types of Documents Borrowed

An effort was made to study the types of documents borrowed by various agricultural libraries for catering to the needs of their users. Forty five percent of the agricultural libraries under study were found to borrow books, periodicals, reports, theses and other documents from other libraries, whereas 12 percent of the various agricultural libraries have borrowed books, periodicals and reports for the use of their clientele. Books and periodicals were borrowed by 26 percent of agricultural libraries concerned with agricultural production, whereas 17 percent of the libraries attached to various agricultural institutes have been borrowing books for their clientele. The data showed that the most popular types of documents borrowed were books (100%) followed by periodicals (83%), reports (56%) and theses (44%) and the data is presented graphically in Figure 1. This might be attributed to the non-cooperation extended by the lending libraries in the case of non-conventional literature.

LENDING OF DOCUMENTS

Among the agricultural libraries studied, 70 percent of the AUML, 69 percent of the OACL and 40 percent of the OVCL, all the NRIL, 91 percent of DRIL and 80 percent of the CRIL are lending books and other documents to other libraries. Among the libraries attached to other research institutes of miscellaneous interest, 64 percent were found to lend documents. The most popular documents lent were books (100%) followed by periodicals (82%), reports (59%) and theses (24%) and the same is presented in Figure 1.

The number of documents (periodicals, reports, theses) lent and received/borrowed by the agricultural libraries were found to be not similar. The agricultural libraries were found to borrow more number of documents, when compared to the number of documents they lent. This may be due to the number of agricultural libraries participating in the ILL service. Also, as mentioned earlier few libraries (viz. IARIL, UASCL, MPAUCL, PKUCL) which are more resourceful appeared to have issued more number of documents to other libraries than what they borrowed from them.

RESPONSE TO BORROWING OF DOCUMENTS

An effort was made to obtain the response of various agricultural libraries in respect of borrowing. The response for the request of book loans was considered to be positive by 92 percent of the AMUL, 67 percent of the OACL and 83 percent of the OVCL. Among the libraries attached to ICAR institutes, 60 percent of the NRIL, 90 percent of the DRIL and 40 percent of the CRIL also received good response in borrowing the books and other documents from other libraries. Fifty percent of the libraries attached to other research institutes of miscellaneous interest received the documents requested for.

In general, the response for the request of book loan was considered to be positive by 85 percent of the agricultural libraries under study. Seventy five percent of the libraries for which were lending expressed the opinion that the request for lending of documents was considerable, whereas the rest of the libraries expressed that it was poor.

NUMBER OF DOCUMENTS BORROWED AND LENT

A comparison was made among various agricultural libraries, between the number of documents borrowed, the number of documents lent and the total document collection.

National Research Institute Libraries

Among the NRIL, the Indian Agricultural Research Institute Library (IARIL), New Delhi is lending, on an average, six times the number of documents it is borrowing. It is quite natural for a national library with a voluminous collection of 4,80,000 documents to be requested for loan of documents. However, it is strange that National Dairy Research Institute Library, Karnal (NDRIL) is borrowing three times the number of documents it is lending. It might be due to earlier literature being available at the library attached to the southern regional station which was started much earlier (1923) as the Imperial Institute of Animal Husbandry than the NDRIL which was established in 1955 [1]. Besides it might be possible that they are borrowing perepheral literature from Indian Veterinary Research Institute Library, Izatnagar which has got collection of 1,25,000 documents.

Agricultural Univerisity Main Campus Libraries

Among the AUML, all the libraries borrowed and lent, on an average, the same number of documents during the period of study, irrespective of their document collection. However, the University of Agricultural Sciences Library, Bangalore (UASCL), Mahatma Phule Agricultural University Central Library (MPAUCL), Rahuri, Punjabrao Krishi Vidyapeeth Library (PKVCL), Akola, and the Gujrat Agricultural University, Anand Campus library respectively were found lending comparatively a larger number of documents (136,79,54 and 41) than borrowing. The larger number of documents that are being loaned by UASCL might be due to the fact that they are providing literature to off-campus libraries and to scientists at research stations situated away from the main campus.

Off-Campus College Libaries

Among the libraries attached to the off-campus agricultural, veterinary and fishery colleges, Agricultural Collage Library, Dharwad (now University of Agricultural Sciences, Dharwad) and Agricultural College Library, Bapatla were found to borrow more number of documents when compared to the number of documents lent to other libraries. Whereas the College of Agricultural Library, Junagadh (Gujrat) have lent on an average (28 and 29), a comparatively larger number of documents when compared to the number of documents borrowed (20). The rest of the libraries have borrowed and lent almost the same number of documents.

Discipline-Oriented Research Institute Libraries

The National Academy of Agricultural Research Management Library, Hyderabad (NAARML) and Indian Agricultural Statistical Research Institute Library, New Delhi (IASRIL), of the discipline oriented research institutes category were found to borrow an average of 50 and 35 documents respectively during the period under study and lent 150 and 70 documents respectively. The NAARML is specializing in management of agricultural research and the IASRIL is specializing in agricultural statistics. The higher rate of lending of documents than borrowing by the NAARML and IASRIL might be due to their collection of documents being perepheral to agricultural sciences; the first one specializing in agricultural research management and the second one specializing in agricultural research statistics.

Commodity Research Institute Libraries

The Central Tobacco Research Institute Library, Rajahmundry (CTRIL) of the commodity research institutes category was borrowing a larger number of documents (50) than the number of documents which were lent (18). This high rate of borrowing of documents might be due to the lack of peripheral literature. The rest of the libraries attached to the commodity research institutes were found to borrow and lend almost equal number of documents.

Other Research Institute Libraries

Among the libraries attached to other research institutes of miscellaneous interest the International Crops Research Institute Library, Patancheru was found to be exceptional in respect of exchange of documents than any other agricultural library studied. The ICRISATL borrowed and lent an average number of 230 and 320 document respectively. The high ratio of lending might be due to its unique collection on the five mandatory crops involved in dryland agricultural production.

The involvement in the high rate of exchange of documents might also be due to the international nature of the institute.

CONCLUSIONS

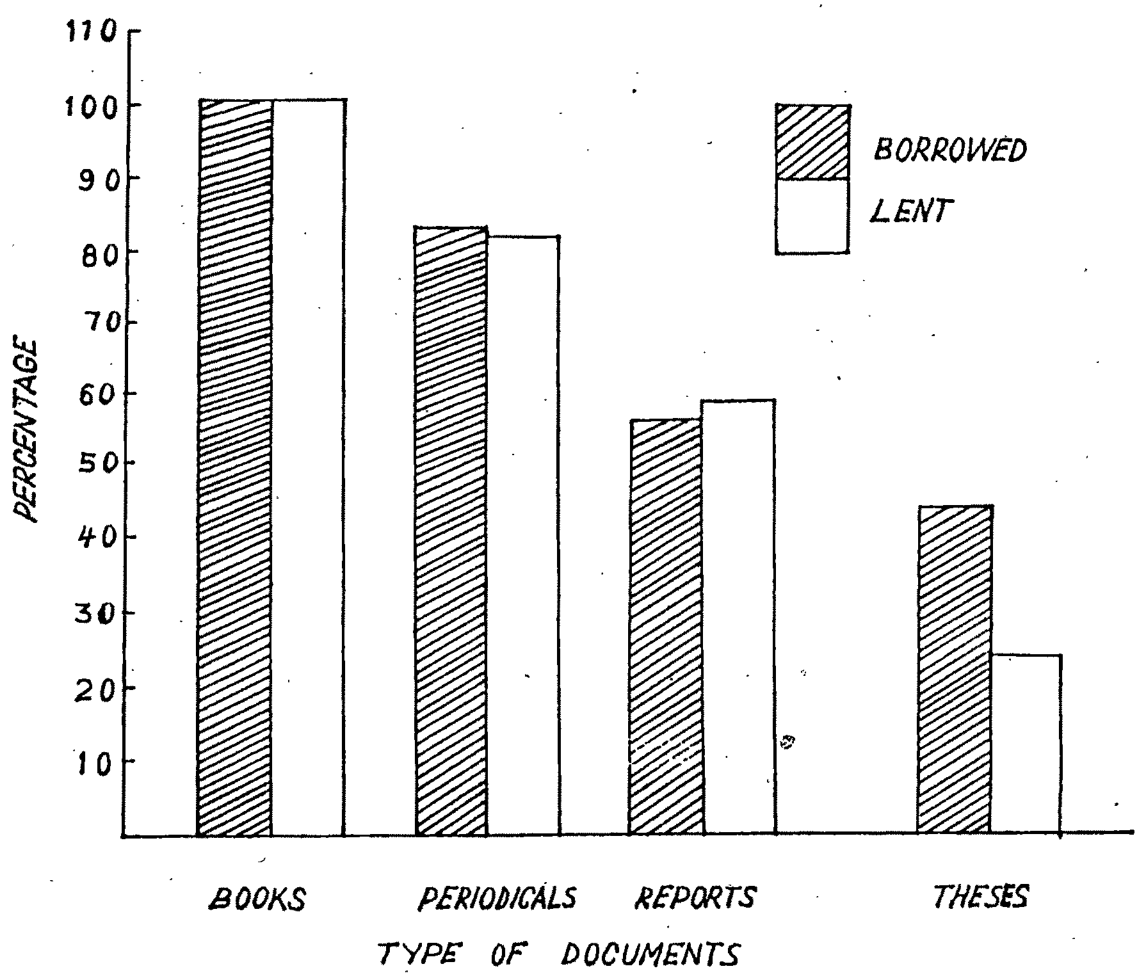
a) As per the recommendations of IFLA a national library or any other appropriate institution may be designated as the National Centre for international lending of documents. Further, the supply of micro-fiche copy of the documents requested is suggested than lending the document in hard copy.

b) It is easier and less costlier to lend or borrow the reading material as photo stat/microfiche.

c) Union catalogue of various types of non-conventional document possessed by the agricultural libraries in India should be compiled, in addition, to the union catalogue of serials for interlending purposes.

d) there is a need for cooperative effort in organizing repository libraries on subject basis to store important, rare and less used documents available with the participating libraries as was pointed out by Rao, Diwakar and Rao [4].

Fig. 1. INTER LIBRARY LOAN SERVICE AMONG THE AG' LIBRARIES



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PRODUCTIVITY OF JOURNALS WHICH PUBLISHED NIGERIAN LIBRARY LITERATURE, 1910-1985

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The productivity of journals which published articles on librarianship in Nigeria from 1910-1985 is studied to determine the number of articles published by each journal, the number of journals that were published in Nigeria and outside Nigeria, the core productive journals that published articles on the literature, the language, subject and title dispersion of journals. The methods adopted were the frequency distribution, percentages and the graphical application of Bradford's law and Chi-square. The observation was that there were four core journals with respect to the Nigerian library literature, 14 (10%) journals were published in Nigeria, title dispersion of journals was low, articles were predominantly in English (99.7%). The dominant subject of the journals was librarianship (70.3%), the number of articles published in Nigerian based journals is higher than those published in foreign journals and that the difference is statistically significant.

INTRODUCTION

Journals constitute the bulk of the literature in any discipline and serve as the forum where different intellectual contributions are made by different authors and carry current information in the subject field.

The objective of this article is to examine the productivity of journals that published articles on librarianship in Nigeria from 1910 to 1985, as follows:

a) to determine the number of articles publislhed by each journal,

b) to find out the number of journals published in Nigeria and outside Nigeria,

c) to determine the number of core journals that published articles on the literature,

d) to determine the language, subject and title dispersion of the journals and

e) to determine if there is any significant difference in the number of articles published by Nigerian and non-Nigerian journals.

CONCEPTUAL FRAMEWORK AND PREVIOUS STUDIES

Journal productivity refers to the number of articles published by a journal over a given period of time. It connotes that the journals that publish more number of articles on a subject are more productive than others. It also implies that journals that regularly publish articles on a subject can be relied upon for information on that subject than those which publish occasionally or no articles on the subject. The identification of productive journals in a field enables the librarian with limited budget to purchase the most productive journals for his library. Journal productivity studies can be traced to Samuel Clement Bradford [4] who studied the journal literature of applied physics and lubrication and observed a phenomenon which led him to formulate his famous law of scattering:

"If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into nucleus of periodicals more particularly devoted to the subject and several other groups or zones containing the same number of articles as the nucleus, then the number of periodicals in the nucleus and the succeeding zones will be in the ratio 1: a : a^2......"

Several studies have been conducted on journal productivity. These include cancer research and tropical agriculture [10], acid rain [8], entomology [6], African trypanosomiasis [12], geographical literature [13], library and labour literature on Nigeria [1, 2], toxicity [11], scientific literature [5], soil science [7], etc. Attempt is made to make a similar study of the Nigerian library literature.

METHODOLOGY

The number of articles produced by each journal title was recorded and the data is presented in Table 1. To determine the core number of productive journals, the graphical formulation of Bradford's law was applied to the data. The language of each journal title was ascertained. The journal title dispersion was determined from the graphical formulation of Bradford's law. The Chi-square method was adopted to test the following hypothesis:

"There is no significant difference in the number of articles in journals published in Nigeria and those published outside Nigeria."

FINDINGS

The Bradford - Zipf bibliograph in figure 1 was produced from the data. From Table 1, it is clear that 139 journals produced 1,548 articles. The highest number of articles produced by an individual journal was 308 followed by 203, 121, 106 and so on.

The graph drawn conformed with a typical Bradford - Zipf bibliograph and it revealed an initial curve that runs into a straight line which eventually deviates to the right. From the graph, four journals were determined to be located within the nucleus or core zone. They altogether contributed 738 (or 47.7%) articles constituting the first zone. The journals and the number of articles they produced are: Nigerian Libraries (308), Library Scientist (203), Nigerbiblios (121) and Lagos Librarian (106). The graph also reveals that 75 journals that produced a total of next 750 articles constituted zone 2, while 60 journals which produced the last 60 articles constituted zone 3.

The analysis also revealed that out of the 139 journals only 14 (10%) journals were published in Nigeria. The remaining journals (90%) were published outside Nigeria. The fourteen Nigerian journals accounted for 932 (60.2%) from a total of 1,548 articles while the non-Nigerian journals produced 616 (39.8%) articles. Out the 14 library science journals that contributed to the literature during the period of study, 7 (50%) are no longer published. The currently published journals are: Nigerian Libraries (308), Library Scientist (203), Nigerbiblios (121), Lagos Librarian (106), Library Focus (16), Nigerian Journal of Library and Information Science Review (9) and Bendel Library Journal (29). The foreign journals that have published ten or more articles are International Library Review (70), UNESCO Bulletin for Libraries (50), Libri (33), New Library World (19), Library Association Record (18), International Library Movement (14), Library Trends (13), Journal of Librarianship (10), School Library Notes (10).

The title dispersion of the journal literature revealed from the graph is 1. This was determined by the point at which the dotted line passing through the linear portion of the bibliograph meets the horizontal axis. The higher the figure obtained, the higher is the extent of scattering of articles among journals. On the other hand, the lower the figure obtained, the lower is the extent of scattering of articles among journals. The value of title dispersion, i.e. 1, obtained in this study obviously points to the act that the extent of scattering of articles among journals is low.

The language distribution of the articles revealed that 1,544 (99.7%) articles were published in English language while the remaining 4 (0.3%) articles were published in other languages. These other languages are Russian 2 (0.13%), French 1 (0.06%) and Scandinavian 1 (0.06%).

Table 2 about the subject distribution of the journal shows that the dominant subject of the journals containing the Nigerian library science literature was library science with 97 (70.3%) titles. It was followed by general journal titles, i.e. 22 (15.6%). Two titles in the field of archives had published library science literature. Publishing and education accounted for 5 titles (3.6%) each while history, architecture, behavioural sciences, biological sciences, computer technology, literature and agronomic education had only 1 title (0.72%) each which published the Nigerian library science literature.

One of the objectives of the study was to test the hypothesis that there is no significant difference in the number of articles published in Nigerian journals and those published outside the country. When the Chi square statistical method was applied to the data, it was revealed that with 1 degree of freedom at 5% level of significance, the calculated Chi - square value of 19.3 was greater than the critical value of 6.6. It, therefore, follows that the null hypothesis is rejected. There is, therefore, a significant difference in the number of articles published in Nigerian and Foreign based journals. The number of 932 articles published in Nigerian based journals is significantly higher than the 616 published in foreign journals.

Table 1.

Journal Productivity in Decreasing Order of Library Literature in Nigeria, 1910-1985

No. of Articles per Journal A	No. of Titles B	Cumulation of Titles C	A X B	Cumulation of Articles	Cumulative Percentage of Articles
308	1	1	308	308	19.9
203	1	2	203	511	33.0
121	1	3	121	632	40.8
106	1	4	106	738	47.7
90	2	6	180	918	59.3
70	1	7	70	988	63.8
50	1	8	50	1038	67.1
33	1	9	33	1071	69.2
29	1	10	29	1100	71.1
23	1	11	23	1123	72.5
20	1	12	20	1143	73.8
19	1	13	19	1162	75.1
18	1	14	18	1180	76.2
16	1	15	16	1196	77.3
14	2	17	28	1224	79.0
13	1	18	13	1237	79.9
12	1	19	12	1249	80.6
11	1	20	11	1260	81.4
10	2	22	20	1280	82.7
9	2	24	18	1298	83.8
8	1	25	8	1306	84.4
7	2	27	14	1320	85.2
6	4	31	24	1344	86.8
5	6	37	30	1374	88.8
4	8	45	32	1406	90.8
3	14	59	42	1448	93.5
2	20	79	40	1488	96.1
1	60	139	60	1548	100.0

Table 2.

Subject Distribution Of Journals That Published Articles on Librarianship In Nigeria, 1910-1985

Sl.No.	Subject	No. of Journals	Percentage
1.	Library Science	97	70.3
2.	General	22	15.6
3.	Education	5	3.6
4.	Publishing	5	3.6
5.	Archives	2	1.4
6.	Agronomic Education	1	0.72
7.	Architecture	1	0.72
8.	Behavioural Science	1	0.72
9.	Biological Sciences	1	0.72
10.	Computer Technology	1	0.72
11.	History	1	0.72
12.	Literature	1	0.72

BRADFORD-ZIPF BIBLIOGRAPH OF JOURNAL
PRODUCTIVITY TO LIBRARY LITERATURE ON
NIGERIA, 1910 - 1985

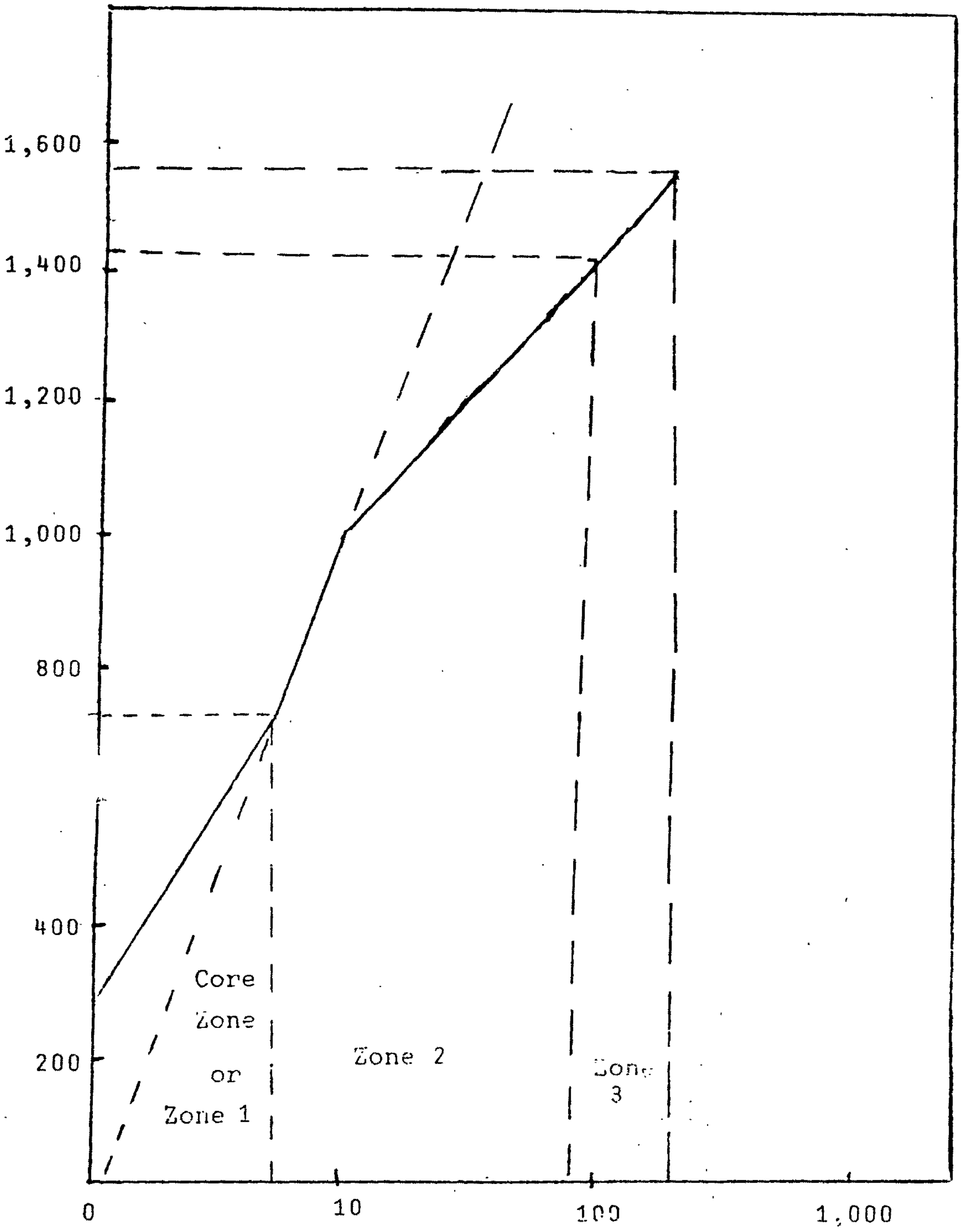

FIG. 1 Logarithm of Journals

DISCUSSION

The study determined four core journals in the literature. This figure is rather low considering the fact that there were 139 journals that published literature on the subject. Although only 14 journals originated from Nigeria, it is worth noting that they published significantly larger number of articles (932) than the non-Nigerian journals. English language was dominant language of the literature. This may be attributed to the fact that English is the official language of Nigeria. The fact that only seven of the fourteen journals that published articles on the subject are currently publishing is also significant.

The low title dispersion of the journals shows that the literature is not scattered among a wide range of journals. The subject distribution of the journals revealed that the majority of journals containing the literature were the library science journals showing a very low subject dispersion.

SUMMARY AND CONCLUSION

This study provided a statistical analyses of the library literature in Nigeria from 1910-1985. It determined the following:

a) there were four core journals,

b) the title and the subject dispersions were low,

c) the dominant language of the journals was English,

d) 14 journals were published in Nigeria while 125 journals were published outside the country,

e) seven out of the fourteen were ceased publications,

f) the number of articles published by the Nigerian journals is significantly higher than those by the non-Nigerian journals.

The null hyphothesis that there is no significant difference in the number of articles produced by Nigerian and non-Nigerian journals was rejected. Therefore, the journals, particularly those on library and information science published in Nigeria were the major producers of the literature. However foreign journals such as International Library Review, UNESCO Bulletin for Libraries and Libri contributed significantly to the literature. Librarians and researchers would find the four core journals and productive foreign journals identified in this study useful in locating Nigerian library literature.

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SCIENTOMETRIC STUDY OF EXPLORATION GEOPHYSICS-AUTHOR PRODUCTIVITY TRENDS

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A cumulative index of geophysics for the two most important journals "Geophysics" and "Geophysical Prospecting" in the field of exploration geophysics for the period 1936-1985 was analysed for author productivity trends. Author Productivity trends were tested for the application of Lotka's law by applying K-S statistical test. Two files were generated out of this data base; one for the period 1936-1985 and the other for the period 1936-1976 to test the time sensitivity of Lotka's law. Lotka's law did not apply as inverse square law but could apply satisfactorily with exponent value of 2.1 on author productivity distribution patterns of both the files.

INTRODUCTION

Bibliometric regularities, recently generalised and renamed by Bookstein [1] as "Informetric regularities", have been studied in varied situations to understand various characteristics of literature in science and technology, social sciences, arts and humanities and their producers. The interest in this area of research has been increasing for the past couple of decades as evidenced by the bibliography of such studied compiled by Hjerppe [6] now needs updating), publication of the journal "Scientometrics", devoted to this field organisation of the first international conference on "Informetrics" - iniated by Egghe and Rousseau [2] in 1987 and about a hundred doctoral dissertation submitted to the American Universities [17]. Describing the importance and robustness of informetric laws, bookstein [1] mentioned that of all the informetric regularities, Lotka's law is the most consistent with traditional statistical description. Numerous empirical studies applying Lotka's law on author productivity data from various subjects have been reported in the literature. The law has been applied on author productivity data collected from bibliographies, a journal, a set of journals, cumulative indexes, or from monographic literature. Pao [21] has re-examined the results of such 48 sets of author productivity data, previously reported. Potter [22] has also reviewed previously reported studies conforming or not conforming to the Lotka's law. Vlachy [26] has compiled a bibliography (now needs updating) and many more studies are also reported since its publication. Even some new kinds of studies on application of Lotka's law have been reported - a few on data of regional literature from developing countries [14, 15, 16] a few on data of newly developing subject specialities [9, 12, 19] and one on data of conference literature.

LOTKA'S LAW AND JOURNAL LITERATURE

Rogge [24] was one of the earlier researchers who made an attempt to apply Lotka's law on literature of anthropology using the 40 years cumulative index of the "American Anthropologist (1888-1928) and the 30-years cumulative index of "American Antiquity" (1935-1965) and concluded that Lotka's law could be applied to this portion of anthropological literature. Schorr [25] applied Lotka's law on productivity data from journal literature but used the data from only two journals - "College and Research Libraries" and "Library Quarterly" for 1963-1972; this was hardly a representative sample for library science. Radhakrishnan and Kerinzan [23], similarly, studied papers published in "Communications of the Association for Computing Machinery (CACM)" and in the ACM for the period 1968-1972. Data of these studies - Rogge, Schorr and Radhakrishnan - are partial and restricted to a few journals in their subject areas and therefore, can hardly be accepted as representative and suitable samples for such kind of studies. Radhakrishnan and Kerinzan themselves suggested to use a larger database like "Engineering Index" for such studies. In fact, to test the Lotka's law, data should be a representative sample in terms of subject, coverage of literature and time period - possibly a period of at least five years.

GEOSCIENTOMETRIC STUDIES

Not many bibliometric, informetric or scientometric studies related to geosciences have been conducted, and reported in the literature [4-13, 16, 18, 20] excepting a few interesting studies related to geosciences and geophysics. Exploration geophysics is further a subfield of geophysics and relatively younger.

Only one attempt to study the author productivity in the field of geosciences and application of Lotka's law in it has been identified. No such attempt is observed in the area of exploration geophysics [12]. Exploration geophysics is now fairly an established subfield of geophysics and the literature has also been increasing rapidly since 1930s. It was, therefore, decided to apply and test the Lotka's law on the author productivity data in this area.

METHODOLOGY

The study aims at testing the applicability of Lotka's law on author productivity of exploration geophysics for the period 1936-1985. The data for this study have been collected from the cumulative Indexes of "GEOPHYSICS and GEOPHYSICAL PROSPECTING" and other documents of early literature in exploration geophysics. The data is kept in two files as follows:

File No. 1	:	Author productivity data for the period, 1936-1985; 50 years (whole file); and
File No. 2	:	Author productivity data for the period, 1936-1976; 41 years (A subset of the whole file).

K-S statistical test was applied to verify the applicability of the law at 0.01 level of significance. While counting the author, each author whose name has appeared in the byline of the title, was given full authorship.

RESULTS AND DISCUSSIONS

File No. 1: Data set for the period, 1936-1985

A total of 3,910 authors were identified contributing for exploration geophysics during the period. The results of analysis of author productivity and author productivity distribution are given in Table 1. The value of the exponent was determined from the observed data and was found to be 2.1. Observed author proportions were compared with estimated proportions. The maximum difference in estimated and observed values was found to be 0.0234 which is less than K-S statistic value, i.e. 0.0261 at 0.01 level of significance for the data. Therefore, the data fit Lotka's type distribution with exponent value=2.1.

File No. 2: Data set for the period, 1936-1976

A total of 2,459 authors contributed publications during the period, 1936-1976. The results of analysis for these data are given in Table 2. The value of exponent calculated from the observed data was found to be 2.1. Observed and estimated author proportions were compared. The maximum difference in observed and estimated values was found to be 0.0265 which is less than K-S statistic value, i.e. 0.0329 which again shows that the data of file No. 2 also fit Lotka's type of distribution with exponent = 2.1.

In both the cases, when highly prolific authors according to Yablonsky's formula [27] were excluded from the data, author productivity distribution was not affected much.

The summary of the results and data are given in Appendix I, and a list of highly productive authors, i.e. the authors who produced 16 or more papers during the period 1936-1985 along with the variation of their productvity is given in Appendix II.

CONCLUSIONS

Following Observations are made from the analysis and results of the study.

a) An inverse exponential type of author productivity distribution was observed in both the data sets,

b) Lotka's law as inverse square law did not apply in both the cases but could apply satisfactorily with exponent value of 2.1 in both the cases,

c) Slightly lower value of exponent contribution per author was observed in the case of the whole file suggesting that the research field of exploration geophysics is better stabilised during the last decade, i.e. 1976-1985.

d) The subset for a shorter period 1936-1976 (shorter only by a decade) appeared to be a true subset of the whole data set.

e) For a large data of a fairly stabilised subject field collected for a longer period, excluding the highly prolific authors, does not affect much the inverse exponential type of author productivity distribution pattern.

Table 1.

Proportion of Authors, 1936-1985

$\alpha = 2.1$

Number of Contributions	Number of authors	Observed	S_n (X)	Expected	F_o (X)
1	2415	0.6176	0.6176	0.6410	0.6410
2	641	0.1639	0.7815	0.1495	0.7905
3	291	0.0744	0.8559	0.0638	0.8543
4	165	0.0422	0.8981	0.0349	0.8892
5	102	0.0261	0.9242	0.0219	0.9111
6	62	0.0159	0.9401	0.0149	0.9260
7	46	0.0118	0.9519	0.0108	0.9368
8	35	0.0090	0.9609	0.0081	0.9449
9	27	0.0069	0.9678	0.0065	0.9512
10	32	0.0082	0.9760	0.0051	0.9563
11	16	0.0041	0.9801	0.0042	0.9605
12	13	0.0033	0.9834	0.0035	0.9640
13	6	0.0015	0.9849	0.0029	0.9669
14	12	0.0031	0.9880	0.0025	0.9694
15	7	0.0018	0.9898	0.0022	0.9716
16	4	0.0010	0.9908	0.0019	0.9735
17	2	0.0005	0.9913	0.0017	0.9752
18	8	0.0020	0.9933	0.0015	0.9767
19	4	0.0010	0.9943	0.0013	0.9780
20	1	0.0003	0.9946	0.0012	0.9792
21-74	21*				

* 21 authors contributed papers ranging from 21 to 74 (2 authors contributed 21 papers, 4, 22; 2, 23; 1, 24; 3, 26; etc. and the highest number of 74 papers were contributed by only one author.

n = 3910

D Max [$F_0(X) - S_n(x)$] = 0.0234

At 0.01 level of significance,

K-S statistic = $1.63/\sqrt{3910}$
= 1.63/ 62.53
= 0.0261

D<0.0261, therefore, data fit with exponent value = 2.1

Table 2.
Proportion of Authors, 1936-1976

Number of contributions	Number of authors	Observed	S_n (X)	Expected	F_o(X)
1	1537	0.6251	0.6251	0.6410	0.6410
2	394	0.1602	0.7853	0.1495	0.7905
3	196	0.0797	0.8650	0.0638	0.8543
4	115	0.0468	0.9118	0.0349	0.8892
5	54	0.0220	0.9338	0.0219	0.9111
6	46	0.0187	0.9525	0.0149	0.9260
7	25	0.0102	0.9627	0.0108	0.9368
8	17	0.0069	0.9696	0.0081	0.9449
9	12	0.0049	0.9745	0.0063	0.9512
10	20	0.0081	0.9826	0.0051	0.9563
11	8	0.0033	0.9859	0.0042	0.9605
12	8	0.0032	0.9891	0.0035	0.9640
13	3	0.0012	0.9903	0.0029	0.9669
14	4	0.0016	0.9919	0.0025	0.9694
15	2	0.0008	0.9927	0.0022	0.9716
16	2	0.0008	0.9935	0.0019	0.9735
17	3	0.0012	0.9947	0.0017	0.9752
18	3	0.0012	0.9959	0.0015	0.9767
19	1	0.0004	0.9963	0.0013	0.9780
20	1	0.0004	0.9967	0.0012	0.9792
21-41	8*				

* 8 authors contributed papers ranging from 21 to 41 (21, 22, 23, 34 and 41 papers were contributed by one author each while 3 authors contributed 25 papers each).

Total Number of authors $n = 2459$

D Max $[F_o (X) - S_n (X)] = 0.0265$

At 0.01 level of significance,

K-S statistic $= 1.63/\sqrt{2459}$

$= 1.63/ 49.58831$

$= 0.0329$

$D<0.0329$, therefore, data fit with exponent value = 2.1

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Appendix I

EXPLORATION GEOPHYSICS, 1936-1985

Summary of Data and Results

Parameters	File 1 1936-1985	File 2 1936-1976
Total number of contributions	4,735	3,011
Total number of authors	3,910	2,459
Contributions per author	1.21	1.22
exponent	2.1	2.1
S	1.560	1.560
K	0.6176	0.6251
D max	0.0234	0.0265
*	0.0261	0.0329
High producers according to Yablonsky	1 (74 Publications)	1 (41 publications)

S - Summation of all the proportions of authors;
K - constant in Lotka's law/equation (generalised and modified form; the value is determined from the observed data);
D max - maximum difference in observed and a estimated author proportions;
* - K-S statistic at 0.01 level of significance for the data.

Appendix II

Rank List of Authors who have Contributed 16 or more Papers in Exploration Geophysics during 1936-1985

	Name of the authors	Contributions					Started publishing in
		upto 1985		upto 1976		during 1976-1985	
		Number	Rank	Number	Rank		
1.	Ward S H	74	1	41	1	33	1953; 1959
2.	Roy A	47	2	34	2	13	1961;
3.	Wait J R	36	3	25	4	11	1951;
4.	Levin F K	33	4	17	11	16	1955;
5.	Hammer S	32	5	21	7	11	1938-76
6.	Treitel S	31	6	17	11	14	1966;
7.	Koefoded D	30	7	25	4	5	1954;
8.	Bhattacharyya BK	29	8	20	8	9	1955;
9.	Clark R D	27	9	-	-	27	1982-85
10.	Thyssen B	26	10	23	5	3	1956;
11.	Hohmann G W	26	10	5	-	21	1970;
12.	Nettleton L L	26	10	26	3	-	1939;
13.	Robinson E A	24	11	16	12	16	1953;
14.	Clarebout J F	23	11	9	-	14	1964-85
15.	Hubral P	23	11	7	-	16	1976;
16.	Safar M H	22	12	3	-	19	1984;
17.	Morrison H F	22	12	12	-	10	1968-76
18.	White J E	22	12	18	10	4	1953;
19.	Dix C H	22	12	22	6	0	1939-72
20.	Ursin B	21	13	0	-	20	1979;
21.	West G F	21	13	9	-	12	1965;
22.	Steenland N	20	14	17	11	3	1964;
23.	Ziet I	19	15	19	9	0	1948-76
24.	Dobrin M B	18	16	18	10	0	1942-71
25.	Rosaire E E	18	16	18	10	0	1936-52
26.	Krey T G	16	17	16	12	0	1951-73

Note : In all there are 126 contributors who have published 10 or more papers during 1936-1985; out of them, 30 have withdrawn after 1976 (they did not contribute any paper during 1976-1985) from active publication activity. Only eight new authors have entered publishing after 1976.

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PRODUCTIVITY MEASUREMENT FOR A LIBRARY

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The paper formulates and applies a simple productivity measurement model for a library. It is essential to measure the productivity of a library for better management. The proposed method is called objective matrix. It is multi-attribute operation oriented system which can be easily applicable in a library. This method incorporates participation, motivation and responsibility unlike the traditional output/input models.

INTRODUCTION

Assessment of productivity of anyorganisation is themost important task, irrespective of whether it is engaged in profit/nonprofit and manufacturing/ service activities. Despite being defined and interpreted in anumber of ways, there is a noconsensusonwhat exactly the term "productiviity"stands for. Broadlyspeaking, productivity refers toa comparison between the quantityofgoods and services produced and delivered and the quantity of resources employed in turning out thesegoods or services. As against the conventional concepts of productivity like ratio of output over input, the productivity as a system's concept implies a broader meaning. It represents the over-all efficiency of the system. It shows how a system is performing to achieve its objectives or goals.

Library is a service organisation and it must justify its budget by the degree of service it renders. To do this, the librarian willfind it useful to quote a measure of the degree to which the library is satisfying its clientele. It is necessary to measure the productivity in a library showing how far the library has been successful in achieving its objectives.

NEED OF PRODUCTIVITY IN LIBRARY

Different parties concernd with the library have different perceptions or expectations regarding the productivity of the library. This results in an expectational incongruency.

For the librarian, higher productivity means less number of complaints, less absenteeism, more number of services, more satisfaction of users, faster service, more budgetary allocation, etc.

For the library staff, higher productivity means more involvement in decision making, more leisure time, more overtime, better promotion and growth, sympathetic understanding of their problems, etc.

For users, a more productive library is considered to provide the required service at a faster speed and lower price.

For authorities of the institute of which the library is a part, higher productivity means a better image of the library in the eyes of users, more discipline in the library, better utilization of budgetary allocation, proper maintenance of the building and other facilities, etc.

The suppliers of books and journals associate continuity of supply, quick payment and maximum profit with the productivity of the library.

The expectations of various parties from a library may not always be conflicting. They could be complementary in some respects. This expectational in congruency clearly shows that the issue of productivity as linked with library like any other case is multidimensional. Any measure of productivity must take into account all these expectations in a rational manner, in total perspective.

The service provided by the library is evaluated on the basis of its quality as well as the cost. The customer interprets quality of service in terms his satisfaction when visiting the library and the price in terms of the benefits gained from the visit. Hence, it is necessary that the quality of service is improved for giving more satisfication to the users. The quality of a service is better, when the

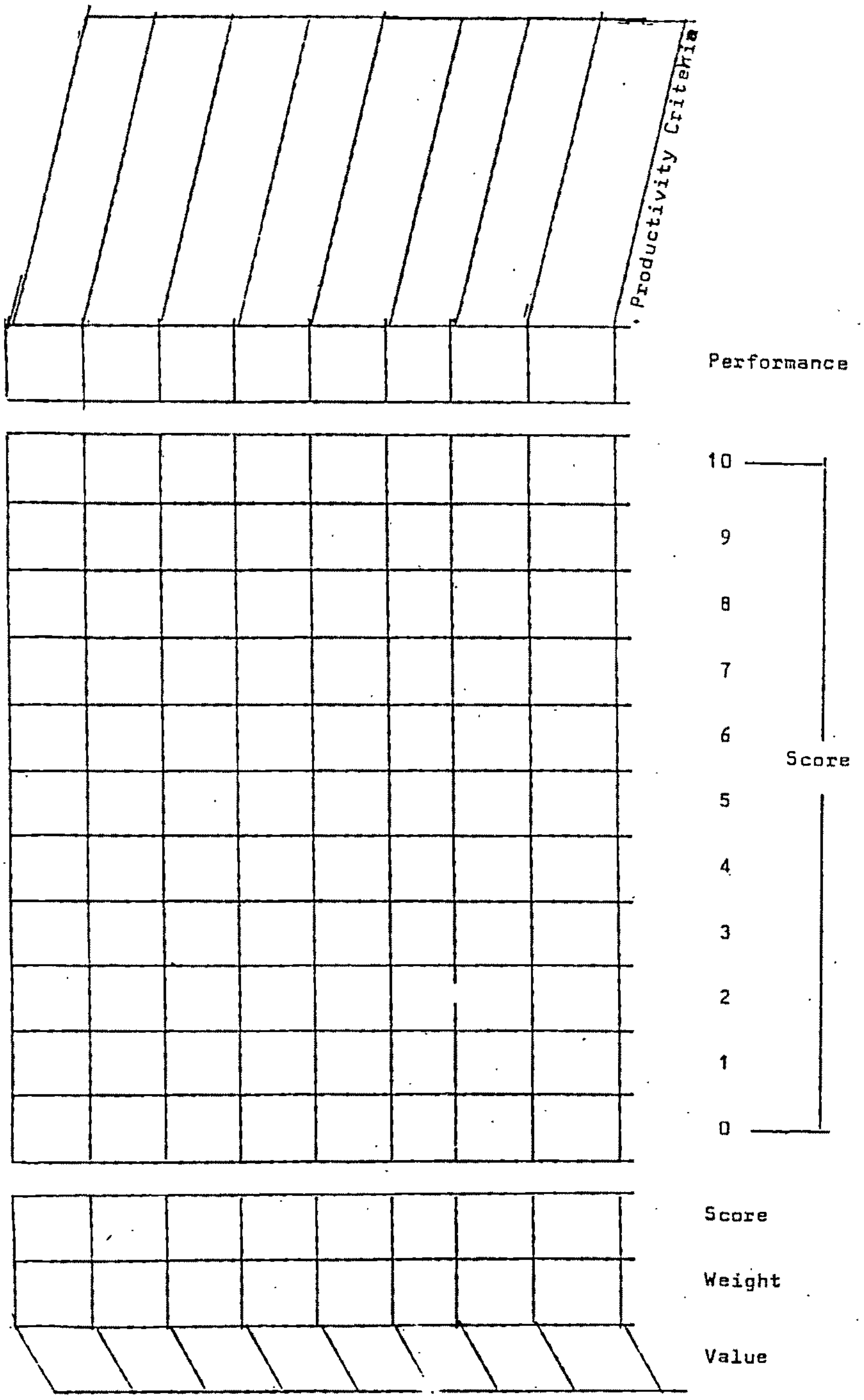

Fig- 1 Format for a Matrix

library is more productive, i.e. the resources are used efficiently and effectively. It is in this context that managing the productivity or measuring the productivity of a library is essential.

PRODUCTIVITY MEASUREMENT SYSTEM

The fear of people to being measured is mainly due to an inadequate measuring system. A good productivity measurement system must show how the input is related to the output. The accountants/manager's measures of productivity such as partial productivity measure, total factor productivity measure or total productivity measure are nothing more than some figures which hide more than what they reveal. However sophisticated the models may be, they do not reveal exactly 'who' is doing 'what', 'how' and 'why'.

A good measurement system should take into consideration all the critical factors which contribute to the productivity of an organisation. It should acknowledge the responsibilities associated with the factors. The measuring system should have an in built mechanism for correction and improvement. The people working for certain goal must know whether performance was 'good' or 'bad'. The characteristics of an acceptable measurement system are feasibility, consistency, accuracy, fairness, understandability, timeliness and cost effectiveness. These characteristics may be defined as follows:

Feasibility	-	Required data are available
Consistency	-	procedure and results are repeatable
Accuracy	-	measures what is sought
Fairness	-	unbiased, trusted
Understandability	-	clear methods & results
Timeliness	-	provides feedback promptly
Cost effective measurement	-	economical

OBJECTIVE MATRIX

The design of an objective matrix resembles an orthogonal format Fig. 1. The process of matrix construction starts with a group of workers identifying the criteria for productivity in their areas of operation. This involves their participation. Then a rating scale for each criterion is constructed based on the future performance goal. This motivates the group for better performance. Then weights for relative importance of the criteria are set by a higher level of management. This shows 'who' should be accountable for 'what' and by 'how much'. At the time of evaluation, the performance level is ascertained from the extent of achievement. The performance levels are of 10 discrete steps. This performance score is multiplied by the corresponding weight and the sum of the products is defined as the productivity index for the period. This index helps in monitoring and feedback of the library system.

OBJECTIVE MATRIX FOR A LIBRARY

The people responsible for the performance in a library are the librarian, his staff and the attendants. This is the functional group whose productivity measurement is sought for. All the members of library share the same identifiable mission. The mission of the group is to provide service. It is difficult to establish the distinguishable output.

Therefore, depending upon the current objectives of the library, (as derived from the supra-system's objectives), the productivity criteria are taken in the form of ratios indicating performance which can certainly be determined. The ratios defined for measuring productivity in a library are as follows:

$$\textit{Revenue Budget Ratio} \quad \frac{\textit{Earining in Rs}}{\textit{Budget in Rs.}}$$

Though earnings are not so important, it is possible for this library to generate revenue which has been it's function over the years by way of training programs, collection of fines, outside membership fees, fees charged from industries for various services like Current Awareness Service, etc. The increasing awareness for becoming self supportive in terms of budgetary needs asks for more of revenue earnings. So this is definitely a performance criteria.

$$\text{Issue Turn-Over Ratio} \quad \frac{\text{Book issue (No. of times)}}{\text{Total No. of Books}}$$

Issue turn-over ratio could be defined as the ratio between the books issued and the total number of books in the library. According to this criteria, more the number of issues, more useful is the

Earning (Rs.) / Budget (Rs.)	Books issued (no.) / Total No. of Books	Missing books (Rs.) / Budget	No. of Participants / No. of training Prog.	Bibliography Provided / Bibliography demended	Membership accepted(Yr / Total Membership	Int.Lib.Loan provided / Int.Lib.Loan requested	Complaints attended / Complaints(Total)	Productivity Criteria	
								Performance	
10	1.5	1.5	20	1.0	0.4	1.0	1.0	10	Score
9.1	1.41	1.71	19	0.99	0.37	0.99	0.98	9	
8.3	1.33	1.93	17	0.97	0.35	0.98	0.96	8	
7.4	1.24	2.14	16	0.96	0.32	0.97	0.94	7	
6.6	1.16	2.36	14	0.94	0.30	0.97	0.91	6	
5.7	1.08	2.57	13	0.93	0.27	0.96	0.89	5	
4.9	0.99	2.79	11	0.91	0.25	0.95	0.87	4	
4.0	0.9	3.0	10	0.9	0.22	0.94	0.85	3	
3.5	0.87	3.67	8	0.87	0.20	0.93	0.73	2	
3.0	0.83	4.33	7	0.83	0.17	0.91	0.72	1	
2.5	0.8	5.0	5	0.80	0.15	0.9	0.70	0	
								Score	
15	20	10	10	5	15	10	15	Weight	
								Value	

Fig-2 Objective Matrix for a library

Index

library. A high issue turn-over ratio shows that a good number of useful books are procured in the library.

$$\textit{Security} \quad \frac{\textit{Missing Books (Cost in Rupees)}}{\textit{Budget (in Rupees)}}$$

This ratio shows how the security in the library is working. As per the supra-system of which the library is a part, the ratio should be 1.5 for the best performance and 5.0 for the worst performance.

$$\textit{Participation Ratio} \quad \frac{\textit{Number of Participants}}{\textit{Number of Training Programms}}$$

This ratio shows the average number of participants in a particular year. A high ratio is desirable for a good productivity system.

$$\textit{Bibliography Service Ratio} \quad \frac{\textit{Bibliography Provided}}{\textit{Bibliography Demanded}}$$

This ratio shows the library's ability to cope up with the demands of bibliography service.

$$\textit{Performance Ratio} \quad \frac{\textit{Membership Accepted}}{\textit{Total Membership}}$$

For a growing library the membership should always grow. Hence, it is an indication of performance.

$$\textit{Resource Sharing Ratio} \quad \frac{\textit{Inter Library Loans Provided}}{\textit{Inter Library Loans Requested}}$$

This ratio shows the library's ability and willingness to allow out-siders to use the facilities in the library and allow its own members to share the facilities available in other libraries.

$$\textit{Response Ratio} \quad \frac{\textit{Complaints attended}}{\textit{Total Number of Complaint}}$$

This ratio shows the library's responsiveness to the user's complaints.

Similarily, various other ratios could be established for different libraries.

PERFORMANCE SCALES

Performance scales are located in the body of the matrix and range from 0 to 10. Each criterion is represented by a column. Levels of performance attributable to each ratio are located in the rows marked 0 through 10. Level '0' is the lowest level of accomplishment in the recent years where the normal operating condition existed. Level '3' corresponds to the current or average level of performance with a look at the recent history of performance. Level '10' is the realistic estimate of result which can be attained in the forseable future with the same resources. Level '0', '3' are benchmarks. Level '10' is the challenge. The established goal objective must be optimistic one which should motivate the library people. The objective matrix established shows the various ratios corresponding to various levels of achievement. The most important thing in the construction of the matrix is that the whole team must decide what is current, pessimistic or optimistic level of performance. Take, for example, the ratio of earning and budget. The current level of performance is 4 and the lowest 2.5. It is decided that the best ratio of performance criterion should be 10. So 2.5 is entered at '0' level, 4 at level '3' and 10 at level '10' in the column under the productivity criterion of earning and budget ratio. Similar ratios for level '0','3' and '10' are decided for all other criteria. Then the figures for intermediate levels are established proportionately.

Weightages

All the ratios or objectives are not equally impor-

Table 1.

Year	Index	% Productivity (Gain/Loss)
1988	385	-
1989	165	57 (loss)
1990	225	36 (Gain)
1991	250	11 (Gain)

Earning (Rs.) / Budget (Rs.)	Books issued(No.of Time / Total No. of Books	Missing books(Rs.) / Budget (Rs.) x1000	No. of participants / No.of training Program	Bibliography provided(no) / Bibliography demanded	Membership accepted / Total Membership	Int.Lib.Loan Provided / Int.Lib.Loan requested	Complaints attended / Complaints(Total)	Productivity Criteria	
3.7	0.92	4.2	8	0.9	0.24	0.94	0.78		Performance (1991)
10	1.50	1.5	20	1.0	0.4	1.0	1.0		10
9.1	1.41	1.71	19	0.99	0.37	0.99	0.98		9
8.3	1.33	1.93	17	0.97	0.35	0.98	0.96		8
7.4	1.24	2.14	16	0.96	0.32	0.97	0.94		7
6.6	1.16	2.36	14	0.94	0.30	0.97	0.91		6 Score
5.7	1.08	2.57	13	0.93	0.27	0.96	0.89		5
4.9	0.99	2.79	11	0.91	0.25	0.95	0.87		
4.0	0.9	3.0	10	0.9	0.22	0.94	0.85		
3.5	0.87	3.67	8	0.87	0.20	0.93	0.73		2
3.0	0.83	4.33	7	0.83	0.17	0.91	0.72		1
2.5	0.8	5.0	5	0.8	0.15	0.9	0.70		
2	3	2	2	3	3	3	2		Score
15	20	10	10	5	15	10	15		Weight
30	60	20	20	15	45	30	30		Value

Figure - 3 Index for 1991

250 Index

tant for the library as a whole. Different ratios qualify for different weightages which is assigned by the people in responsible positions. In this case the weightages are assigned by the librarian. The issue turnover ratio gets a weightage of 20 while the bibliography ratio gets a weight of 5.

PRODUCTIVITY INDEX

At the end of the year, the values of various ratios are calculated and entered in the matrix in the row entitled 'performance'. The appropriate figures are rounded off in the main body. The scores are noted down at the bottom in the boxes. The products of the scores and weights are entered in the 'value' row. Then the values are summed up to arrive at the 'productivity index' for that particular year. The productivity index of the library for last four years as found out is given in Fig. 3 and Table 1.

DISCUSSION

The index as measured for various years show that it achieved a highest figure of 385 in 1988 anda lowest of 165 in 1989. The loss of productivity in 1989 has been 57% and there is a gain of productivity in the subsequent years, the reasons for non-achievement or bad performance were found out and subsequent actions have led to gradual improvements. It is true that the reasons for poor performance were found out and the actions were taken without the help of objective index in the earlier years. But there is no doubt that with the help of objective index the problems could be located easily and an appropriate action could be found for better achievement. Instead of following a method of scratch here and fiddle there, the help of the objective matrix would have been more objective.

CONCLUSION

The establishment of an objective - matrix is easy. Because its inherent strengths are found in participation, motivation and accountability of the members of the group, it proves a good feedback and monitoring systems. It does not only find the productivity figure for a particular year but also highlights the reasons for non-achievement of its goal and the measures to be taken for improvement. It directly pinpoints particular individual or individuals for their negligence or irresponsibility. Such measurement system definitely helps the library to a great extent though it may not be a cure for all productivity ailments and an elixir to stimulate productivity performance.

BOOK REVIEW

ILO Thesaurus : Labour, employment and training terminology. Ed 4. Geneva, International Labour Office 1992. (Reviewed by Mrs. J.K. Ahluwalia)

The ILO thesaurus was originally conceived following the decision of the International Labour Office to computerise information storage and retrieval in the ILO Library's LABORDOC database. The thesaurus was basically meant to be used to convert the International Labour Information System from subject classification of documents to identification of concepts through a system of keywords or descriptors. The fourth edition of the thesaurus contains the English, French and Spanish terminology relating to economic and social development. The terminology of the areas of major concern of the ILO, i.e. labour, manpower and employment, social security, working conditions, wages, occupational safety and health, labour relations, vocational training, management development and personnel management are treated in greater detail.

Many new scope notes, synonyms, broader and narrower relationships between terms have been added to all the three versions of the thesaurus. The terms in the thesaurus are principally composed of nouns or nouns with adjectives, in natural word order and having a maximum length of 50 characters. Abbreviations are excluded in descriptors except as acronyms for organizations and programmes. Trade names and proper names are excluded except for countries and geographical areas. Ambiguous descriptors are followed by scope notes. All descriptors are in the singular except where a plural meaning has been deliberately chosen.

The thesaurus is in two parts. Part 1 contains three separate alphabetical keyword-out of context (KWOC) indexes referring the user to full details on each descriptor given in the systematic display in English, French and Spanish in Part 2. The keywords in part 2 are grouped in ninteen major facets broken down into various sub-facets and sub-sub-facets. It is arranged in three columns to enable users to compare descripters, equivalents and scope notes in each language.

Each descriptor is numbered to facilitate referral from the alphabetical indexes to the systematic display. The date of introduction of all descriptors added since 1978 is given, often followed by a history note indicating descriptors previously used in the LABORDOC databases of ILO.

The thesaurus, running into 557 pages, is an important tool for indexing and retrieval purposes for International Labour Information System as well as other various information services within ILO and any other information system with similar scope of coverage.

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